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U.S. DEPARTMENT OF COMMERCE  
NATIONAL BUREAU OF STANDARDS

**SCREW-THREAD STANDARDS  
FOR FEDERAL SERVICES  
1957**

Amends in part H28 (1944) (and in part its 1950 Supplement)

**HANDBOOK H28 (1957)—Part II**

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NATIONAL BUREAU OF STANDARDS HANDBOOK H28 (1957)

# SCREW-THREAD STANDARDS FOR FEDERAL SERVICES 1957

## PART II

PIPE THREADS, INCLUDING DRYSEAL PIPE THREADS;  
GAS CYLINDER VALVE OUTLET AND INLET THREADS;  
HOSE COUPLING, INCLUDING FIRE-HOSE COUPLING THREADS;  
AND HOSE CONNECTIONS FOR WELDING AND CUTTING EQUIPMENT



Amends in part H28 (1944) (and in part its 1950 Supplement)

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## Foreword

This volume is the second of a series of three into which the 1957 edition of NBS Handbook H28 is divided.

Part I, published in September 1957, includes standards for screw threads which are commonly applied to bolts, screws, nuts, and other similar fasteners. Such threads are variously designated as Unified, American, American National, and Unified Miniature threads.

Part III is in process of development and will include standards for Acme, Stub-Acme, Buttress, and miscellaneous threads.

With the exception of sections IX and X, and appendix 5, Handbook H28 (1944) and the 1950 Supplement thereto, are superseded by Parts I and II of Handbook H28 (1957) and the Federal Specifications listed in appendix 6 of Part I of H28 (1957).

ARCHIBALD T. MCPHERSON, *Chairman,*  
*Interdepartmental Screw Thread Committee.*

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### Reprinted with Corrections

April 1962

Pages 7, 19, 21, 22, 23, 24, 26, 27, 29, 31, 33, 34, 36, 76, 78, 79, 93, 103, 104, 105, 107, 109, 110, 111, and 116 of this reprint contain corrections indicated by a single asterisk.

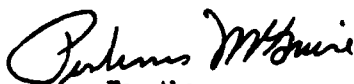
The following are some of the major changes: On page 19, the whole paragraph for 1. MANUFACTURING TOLERANCE ON PRODUCT.—has been replaced. Also, on this page footnote "b" has been added to Table VIII.1. On page 21, Table VIII.3 has been replaced. On page 22, footnote "d" for Table VIII.4 has been added. On page 23, footnote "d" for Table VIII.5 has been added. On page 24, footnote "c" for Table VIII.6 has been added. On page 27 in Table VIII.10, columns 10 and 11 have been replaced. On page 29, the first paragraph of the column, last three lines of this paragraph have been revised. On page 78, in the second column, the "safety device threads" designation has been changed. On page 79, in Table IX.7, columns 8, 9, and 10, have been deleted. On page 110, in the first column, heading 9 and the paragraph for this heading have been revised. On page 116, in the first column, the first part of paragraph 4 has been revised, including a footnote to be added as "14."

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APPROVAL BY THE SECRETARIES OF DEFENSE AND COMMERCE

The accompanying Handbook H28 (1957), Part II, on screw-thread standards for Federal Services, submitted by the Interdepartmental Screw Thread Committee, is hereby approved for use by the Departments of Defense and Commerce.

  
For the  
Secretary of Defense

  
Secretary of Commerce

PERSONNEL OF THE INTERDEPARTMENTAL SCREW THREAD COMMITTEE (1962)

*Representing the Department of Defense:*

MR. ALDEN W. MCDANIEL, Directorate Logistics Services, Defense Supply Agency, Washington 25, D.C.

*Representing the Department of the Army:*

MR. EUGENE VON LOESCH, Directorate of Research and Development, Office of the Chief of Engineers, Department of the Army, Washington 25, D.C.

MR. M. L. FRUECHTENICHT, Gage Laboratory, Frankford Arsenal, Ordnance Corps, Department of the Army, Philadelphia 37, Pa.

*Representing the Department of the Navy:*

MR. JAMES W. JENKINS, Metallurgical and Mechanical Branch, Research Division (Code 343), Bureau of Ships, Department of the Navy, Washington 25, D.C.

MR. J. E. WALTER, Bureau of Naval Weapons, Washington 25, D.C.

*Representing the Department of the Air Force:*

MR. JOSEPH W. EVANS, ASNPFC, Aeronautical Systems Division, Wright-Patterson Air Force Base, Ohio.

MR. FRANCIS L. CALKINS, ASNX68, Aeronautical Systems Division, Wright-Patterson Air Force Base, Ohio.

*Representing the Department of Commerce:*

DR. ARCHIBALD T. MCPHERSON, chairman, Associate Director, National Bureau of Standards, Washington 25, D.C.

MR. IRVIN H. FULLMER, secretary, Chief, Engineering Metrology Section, Metrology Division, National Bureau of Standards, Washington 25, D.C.

*Liaison Representatives of Sectional Committees Organized Under the Procedure of the American Standards Association and Sponsored by The American Society of Mechanical Engineers and the Society of Automotive Engineers, Inc., or the American Gas Association:*

MR. RICHARD B. BELFORD, Technical Adviser, Industrial Fasteners Institute, 1517 Terminal Tower, Cleveland 13, Ohio. (Member of ASA Committees B1 and B18.)

MR. H. C. EEDMAN, Technical Adviser to Pres., The National Screw & Manufacturing Co., 2440 E. 75th St., Cleveland 4, Ohio. (Member of ASA Committees B1 and B18.)

MR. ERNEST S. HELDMANN, Chief Engineer, Holo-Krome Screw Corp., 31 Brooks St., Hartford 10, Conn. (Member of ASA Committee B18.)

MR. RUSSELL F. HOLMES, Technical Assistant, Engineering Standards Section, General Motors Technical Center, General Motors Corp., Detroit 2, Mich. (Member of ASA Committees B1 and B2.)

MR. MILTON A. SCHULTHEIS, Staff Engineer, Engineering-General Office, Hughes Aircraft Co., Culver City, Calif. (Member of ASA Committee B1.)

MR. D. H. SECORD, Pratt and Whitney Division, United Aircraft Corporation, East Hartford, Conn. (Member of ASA Committee B1.)

MR. FRANK TEECH, Vol-Shan Manufacturing Co., division of Vol-Shan Industries, Inc., 8463 Higuera St., Culver City, Calif. (Member of ASA Committee B1.)

MR. W. G. WALTERS, Director of Research, The Lamson & Sessions Company, 5000 Tiedeman Rd., Cleveland 9, Ohio. (Member of ASA Committees B1, B2, and B18.)

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# 1957 HANDBOOK OF SCREW-THREAD STANDARDS FOR FEDERAL SERVICES, Part II

As Approved 1958

## SECTION VII. AMERICAN STANDARD PIPE THREADS (EXCEPT DRYSEAL AND HOSE COUPLING TYPES)<sup>1</sup>

### 1. INTRODUCTION

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

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

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

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

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

Until the manufacturers adopted the Briggs thread in 1886, it seems that each manufacturer of necessity threaded his pipe and fittings according to his best judgment. After 1886 there was some attempt to work toward better interchangeability. However, the need for a better gaging practice resulted in the adoption of the thin ring gage and the truncation of the plug and ring gages

to gage the flanks of the thread. This practice of threading fittings and couplings which provide threads to make up joints with a wrench was standardized about 1913.

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

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

Substantially the same standard for taper pipe threads, but with various additional refinements in gaging, is issued as Military Specification MIL-P-7105.

1. TYPES OF PIPE THREADS.—The various types of pipe threads included in this section have right-hand threads unless otherwise specified.

(a) *Pipe threads*.—The following types of pipe threads are included in this section:<sup>2</sup>

NPT—American Standard taper pipe threads for general use. (p. 2.)

NPSC—American Standard straight pipe threads in pipe couplings. (p. 7.)

NPTR—American Standard taper pipe threads for railing joints. (p. 7.)

NPSM—American Standard straight pipe threads for free-fitting mechanical joints for fixtures. (p. 9.)

NPSL—American Standard straight pipe threads for loose-fitting mechanical joints with locknuts. (p. 9.)

(b) *UNS threads for use on thin-wall tubing*.—Data are included in this section on p. 11 on

<sup>1</sup> This section is substantially in agreement with the present issue of ASA B2.1, "American Standard Pipe Threads (Except Dryseal)," which is published by the ASME, 29 West 39th Street, New York 18, N.Y. The latest revision should be consulted when referring to this ASA standard.

<sup>2</sup> Dryseal pipe threads are included in section VIII, p. 18. American National straight pipe threads for loose-fitting mechanical joints for hose couplings, NPSH, are included in section X, p. 91.

UNS straight threads of the 27-thread series in sizes  $\frac{1}{8}$  to 1 in. for use on thin-wall tubing.

2. **THREAD DESIGNATIONS.**—The letters in the thread designation symbols have the following significance:

N=American (National)<sup>2a</sup> Standard  
P=Pipe  
T=Taper  
S=Straight; also Special  
C=Coupling  
M=Mechanical  
L=Locknut  
R=Railing fittings  
U=Unified

For left-hand threads, add “-LH” to the designation for the corresponding right-hand thread.

3. **APPENDIX.**—Appendix 7 contains the following additional information on the pipe threads covered by this section:

Definitions and letter symbols.

Suggested twist drill diameters for drilled hole sizes for the pipe threads shown in section VII.

Pitch diameters of taper pipe threads shown in their relation to  $E_1$ , basic pitch diameter.

Threading of pipe for American Standard threaded steel flanges.

Taper and straight threads for rigid steel conduit and fittings.

Internal straight pipe threads in finished drums and external threads on plugs.

## 2. AMERICAN STANDARD PIPE THREAD FORM

The form of thread profile specified in this section shall be known as the “American Standard Pipe Thread Form.” There are shown in figure VII.1 the relations as specified herein for form of thread and general notation.

1. **ANGLE OF THREAD.**—The angle between the sides of the thread is  $60^\circ$  when measured in an axial plane. The line bisecting this angle is perpendicular to the axis.

2. **TRUNCATION AND THREAD HEIGHT.**—The height of the sharp V thread,  $H$ , is

$$H = 0.866025p = 0.866025/n$$

where

$p$  = pitch of thread  
 $n$  = threads per inch.

The basic maximum depth of the truncated thread,  $h$  (see fig. VII.1), is based on factors entering into the manufacture of cutting tools and the making of tight joints.

$$h = 0.800p = 0.800/n$$

The crest and root of pipe threads are truncated<sup>3</sup> a minimum of  $0.033p$ .

<sup>2a</sup> The N is derived from earlier nomenclature that included the word “National.”

<sup>3</sup> The crests and roots of the external and internal threads may be truncated either parallel to the pitch line or parallel to the axis.

The maximum depth of truncation for the crest and root of these pipe threads will be found in table VII.1.

The sketch at the head of table VII.2, giving a sectional view of this standard thread form, represents the truncated thread form by a straight line. However, when closely examined, the crests and roots of commercially manufactured pipe threads appear slightly rounded and it is intended that the pipe threads of product shall be acceptable when crest and root of the tools or chasers lie within the limits set up in table VII.1.

## 3. SPECIFICATIONS FOR TAPER PIPE THREADS FOR GENERAL USE, NPT

Threads made in accordance with these specifications consist of an external taper and an internal taper thread, to form the normal type of joint having general application on pipe and fittings. See figure VII.2.

1. **THREAD DESIGNATION AND NOTATION.**—American Standard taper pipe threads are designated by specifying in sequence the nominal size, number of threads per inch, and the symbols for thread series and form as shown in the following example:

3/8—18NPT

Standard notation applicable to American Standard taper pipe threads is shown in figure VII.3.

2. **FORM OF THREAD.**—The form of thread of American Standard taper pipe threads is as specified in pars. 1 and 2, above.

3. **TAPER OF THREAD.**—The taper of the thread is 1 in 16 or 0.75 in./ft. measured on the diameter and along the axis.

4. **DIAMETER OF THREAD.**—The basic pitch diameters of the taper thread are determined by the following formulas<sup>4</sup> based on the outside diameter of the pipe and the pitch of the thread:

$$E_0 = D - (0.05D + 1.1) 1/n = D - (0.05D + 1.1)p$$

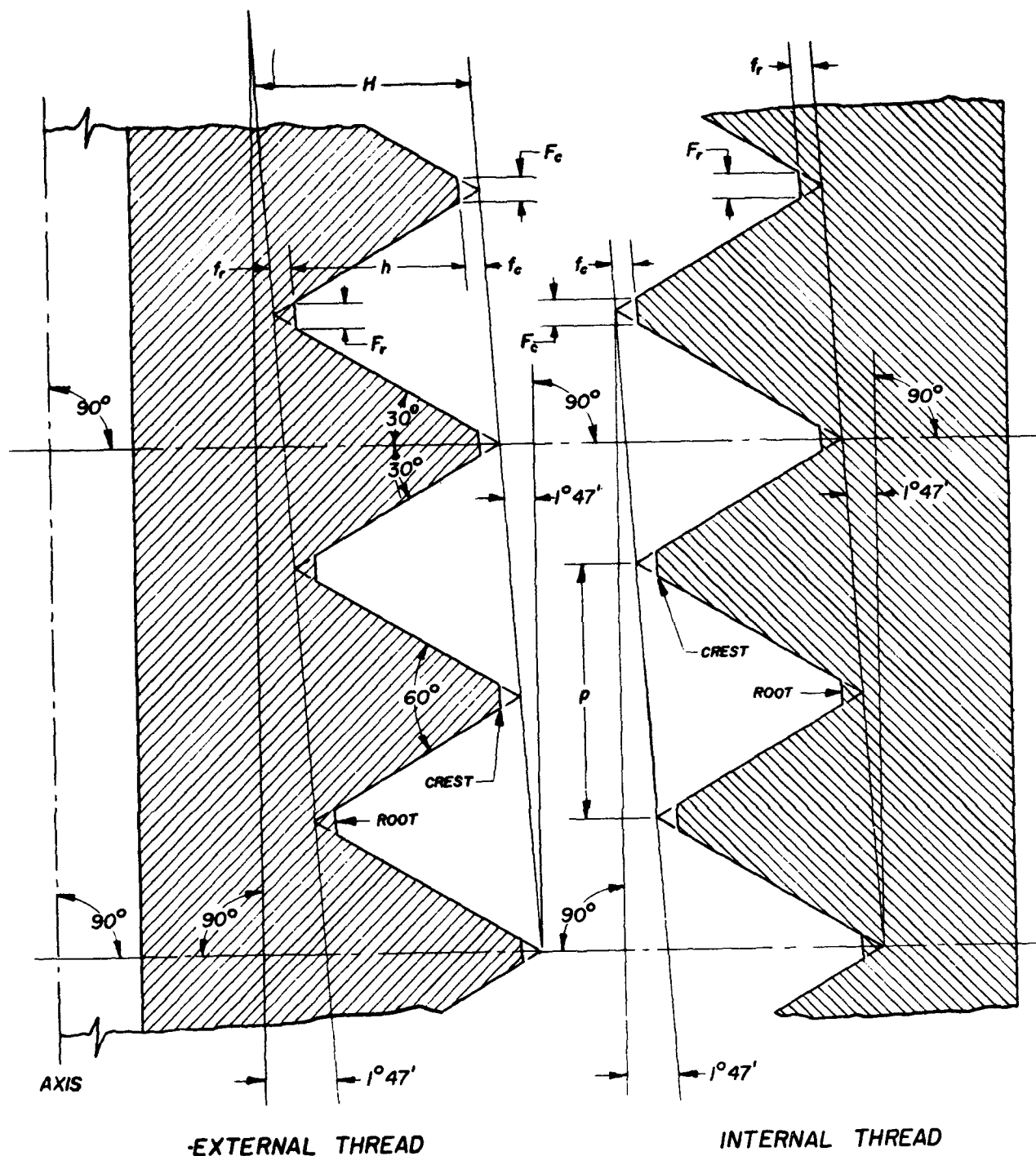
$$E_1 = E_0 + 0.0625L_1$$

where

$D$  = outside diameter of pipe,  
 $E_0$  = pitch diameter of thread at end of pipe,  
 $E_1$  = pitch diameter of thread at the gaging notch or large end of internal thread,  
 $L_1$  = normal engagement by hand between external and internal threads,  
 $n$  = threads per inch.

5. **LENGTH OF THREAD.**—The basic length of the effective external taper thread,  $L_2$ , is determined by the following formula based on the outside diameter of the pipe and the pitch of the thread:

<sup>4</sup> For the 1/8–27 and 1/4–18 sizes,  $E_1$  approx. =  $D - (0.05D + 0.827)p$ .



EXTERNAL THREAD

INTERNAL THREAD

NOT TO SCALE

FIGURE VII.1.—Basic form of American Standard taper pipe thread

NOTATION

$H = 0.866025p$  = height of  $60^\circ$  sharp V thread  
 $h = 0.800000p$  = height of thread on product  
 $p = 1/n$  = pitch (measured parallel to axis)  
 $n$  = number of threads per inch  
 $f_c$  = depth of truncation at crest  
 $f_r$  = depth of truncation at root  
 $F_c$  = width of flat at crest  
 $F_r$  = width of flat at root

NOTE—For a symmetrical straight screw thread,  $H = \cot \alpha / 2n$ . For a symmetrical taper screw thread,  $H = (\cot \alpha - \tan^2 \theta \tan \alpha) / 2n$ , so that the exact value for an American Standard taper pipe thread is  $H = 0.865743p$  as against  $H = 0.866025p$ , the value given above. For an 8-pitch thread, which is the coarsest standard taper pipe thread pitch, the corresponding values of  $H$  are 0.108218 in. and 0.108253 in. respectively, the difference being 0.000035 in. This difference being too small to be significant, the value of  $H = 0.866025p$  continues to be in use for threads of  $3/4$  in. or less taper per foot on the diameter.

$$L_2 = (0.80D + 6.8)1/n = (0.80D + 6.8)p$$

where

$D$  = outside diameter of pipe,

$n$  = threads per inch.

This formula determines directly the length of effective thread which includes two usable threads slightly imperfect at the crest.

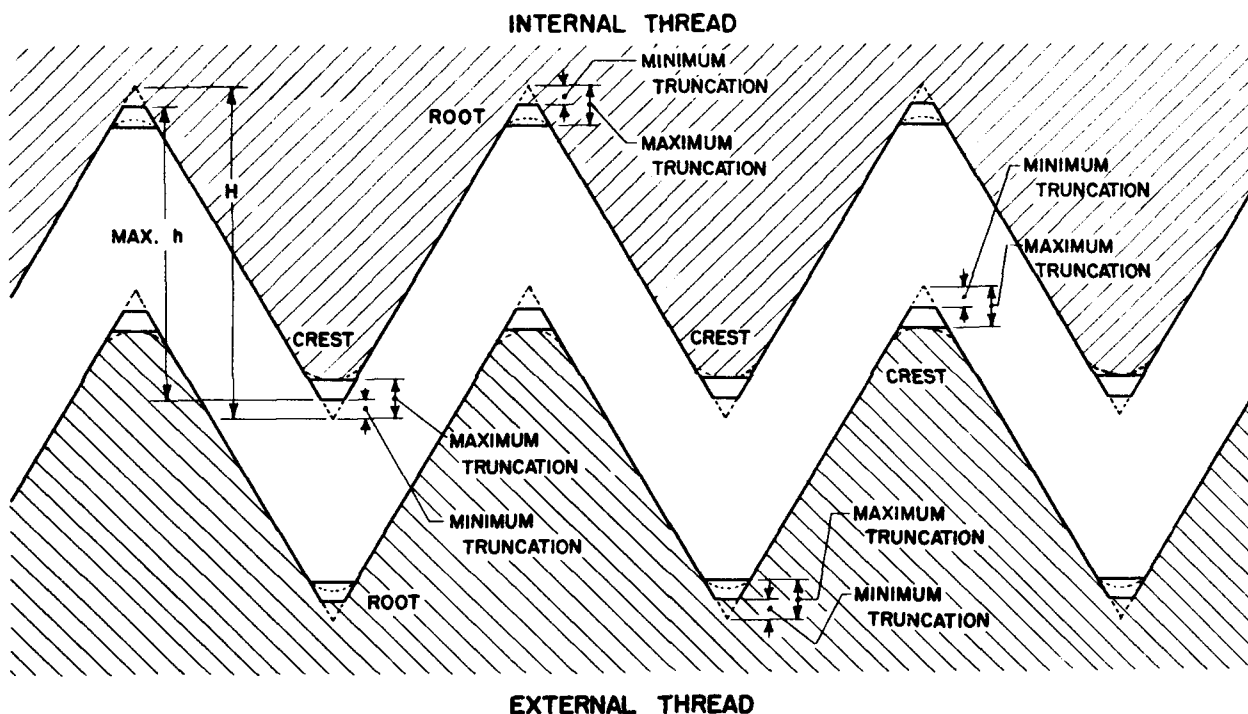
6. ENGAGEMENT BETWEEN EXTERNAL AND INTERNAL TAPER THREADS.—The normal length of engagement between external and internal taper threads when screwed together handtight is shown in column 6, table VII.2. This length is controlled by the construction and use of the gages. It is

recognized that in special applications, such as flanges for high pressure work, longer thread engagement is used, in which case the pitch diameter (dimension  $E_1$  in figure over table VII.2) is maintained and the pitch diameter  $E_0$  at the end of pipe is proportionately smaller.

7. BASIC DIMENSIONS. The basic dimensions of taper pipe threads, derived from the above specifications, are given in table VII.2.

8. MANUFACTURING TOLERANCE ON PRODUCT.—The maximum allowable variation in the commercial product is 1 turn of the inspection (working) gage large or small from the basic dimensions (see pars. 4 and 5, p. 14).

TABLE VII.1.—Limits on crest and root truncation of American Standard external and internal taper pipe threads, NPT<sup>a</sup>



| Threads per inch, $n$ | Height of sharp V thread, $H$ | Height <sup>b</sup> of thread, $h$ |            | Truncation, $f$ |            |                |            |            | Equivalent width of flat, $F$ |            |                |            |            |
|-----------------------|-------------------------------|------------------------------------|------------|-----------------|------------|----------------|------------|------------|-------------------------------|------------|----------------|------------|------------|
|                       |                               | Max                                | Min        | Minimum         |            | Maximum        |            | Tolerance  | Minimum                       |            | Maximum        |            | Tolerance  |
| 1                     | 2                             | 3                                  | 4          | 5               | 6          | 7              | 8          | 9          | 10                            | 11         | 12             | 13         | 14         |
|                       | <i>in.</i>                    | <i>in.</i>                         | <i>in.</i> | <i>formula</i>  | <i>in.</i> | <i>formula</i> | <i>in.</i> | <i>in.</i> | <i>formula</i>                | <i>in.</i> | <i>formula</i> | <i>in.</i> | <i>in.</i> |
| 27                    | 0.03204                       | 0.02963                            | 0.02496    | 0.033 <i>p</i>  | 0.0012     | 0.096 <i>p</i> | 0.0036     | 0.0024     | 0.038 <i>p</i>                | 0.0014     | 0.111 <i>p</i> | 0.0041     | 0.0027     |
| 18                    | 0.04811                       | 0.04444                            | 0.03833    | 0.033 <i>p</i>  | 0.0018     | 0.088 <i>p</i> | 0.0049     | 0.0031     | 0.038 <i>p</i>                | 0.0021     | 0.102 <i>p</i> | 0.0057     | 0.0036     |
| 14                    | 0.06186                       | 0.05714                            | 0.05071    | 0.033 <i>p</i>  | 0.0024     | 0.078 <i>p</i> | 0.0056     | 0.0032     | 0.038 <i>p</i>                | 0.0027     | 0.090 <i>p</i> | 0.0064     | 0.0037     |
| 11½                   | 0.07531                       | 0.06957                            | 0.06261    | 0.033 <i>p</i>  | 0.0029     | 0.073 <i>p</i> | 0.0063     | 0.0034     | 0.038 <i>p</i>                | 0.0033     | 0.084 <i>p</i> | 0.0073     | 0.0040     |
| 8                     | 0.10825                       | 0.10000                            | 0.09275    | 0.033 <i>p</i>  | 0.0041     | 0.062 <i>p</i> | 0.0078     | 0.0037     | 0.038 <i>p</i>                | 0.0048     | 0.072 <i>p</i> | 0.0090     | 0.0042     |

<sup>a</sup> The basic dimensions of the American Standard taper pipe thread are given in inches to four and five decimal places. While this implies a greater degree of precision than is ordinarily attained, these dimensions are so expressed for the purpose of eliminating errors in computations. The limits specified in this table are intended to serve as a guide for establishing limits of the thread elements of taps, dies, and thread chasers. These limits may be required on product.

<sup>b</sup> Dimensions of gages, such as plain taper plug and ring gages, which depend on maximum and minimum truncations, columns 5 to 8, inclusive, shall be determined by applying the thread heights in columns 3 and 4 to the basic pitch diameter,  $E_0$  or  $E_1$ . Step values of tolerance notches are 16 times (col. 3—col. 4), rather than 32 times (col. 9).

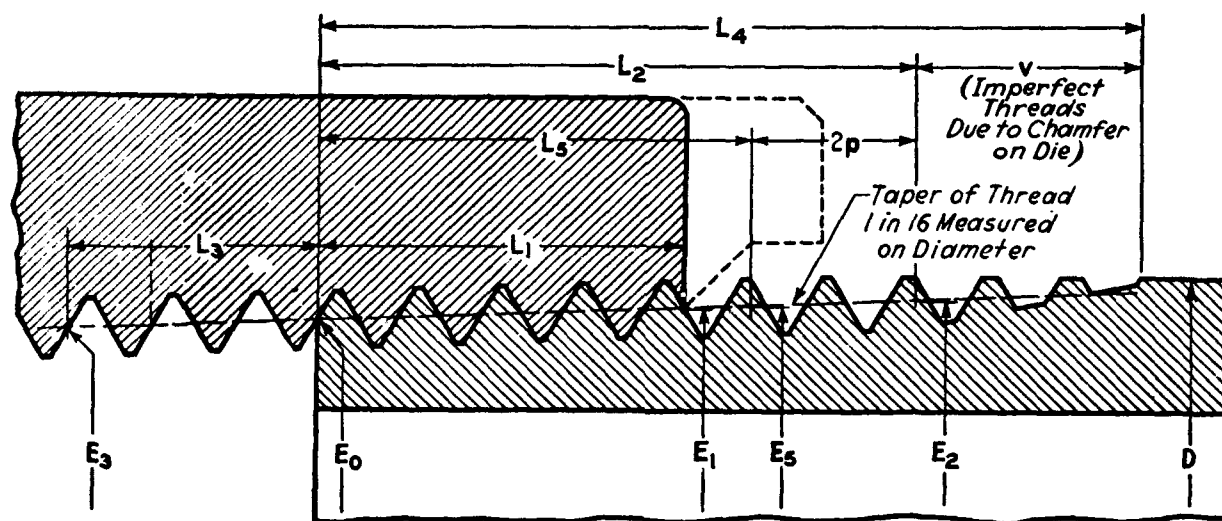
**9. TOLERANCES ON THREAD ELEMENTS.**—The permissible variations in thread elements on steel products and all pipe made of steel, wrought iron, or brass, exclusive of butt-weld pipe, are given in table VII.3. This table is a guide for establishing limits of the thread elements of taps, dies, and thread chasers. These limits may be required on product threads.

On pipe fittings and valves (not steel) for steam pressures 300 lbs. and below, it is intended that

plug and ring gage practice, as set up in this standard, will provide for a satisfactory check of accumulated variations of taper, lead, and angle in such product. Therefore, no tolerances on thread elements have been established for this class.

For service conditions, where more exact check is required, procedures have been developed by industry to supplement the regulation plug and ring gage method of gaging.

TABLE VII.2. — Basic dimensions of American Standard taper pipe threads, NPT <sup>a</sup>



| Nominal pipe size | Outside diameter of pipe, <i>D</i> | Threads per inch, <i>n</i> | Pitch of thread, <i>p</i> | Pitch diameter at beginning of external thread, <i>E</i> <sub>0</sub> | Handtight engagement                       |            |                                              | Effective thread, external                 |            |                                              |
|-------------------|------------------------------------|----------------------------|---------------------------|-----------------------------------------------------------------------|--------------------------------------------|------------|----------------------------------------------|--------------------------------------------|------------|----------------------------------------------|
|                   |                                    |                            |                           |                                                                       | Length, <sup>b</sup> <i>L</i> <sub>1</sub> |            | Diameter, <sup>c</sup> <i>E</i> <sub>1</sub> | Length, <sup>d</sup> <i>L</i> <sub>2</sub> |            | Diameter, <sup>e</sup> <i>E</i> <sub>2</sub> |
| 1                 | 2                                  | 3                          | 4                         | 5                                                                     | 6                                          | 7          | 8                                            | 9                                          | 10         | 11                                           |
| <i>in.</i>        | <i>in.</i>                         |                            | <i>in.</i>                | <i>in.</i>                                                            | <i>in.</i>                                 | <i>ths</i> | <i>in.</i>                                   | <i>in.</i>                                 | <i>ths</i> | <i>in.</i>                                   |
| 3/16              | 0.3125                             | 27                         | 0.03704                   | 0.27118                                                               | 0.160                                      | 4.32       | 0.28118                                      | 0.2611                                     | 7.05       | 0.28750                                      |
| 1/8               | .405                               | 27                         | .03704                    | .36351                                                                | .1615                                      | 4.36       | .37360                                       | .2639                                      | 7.12       | .38000                                       |
| 1/4               | .540                               | 18                         | .05556                    | .47739                                                                | .2278                                      | 4.10       | .49163                                       | .4018                                      | 7.23       | .50250                                       |
| 3/8               | .675                               | 18                         | .05556                    | .61201                                                                | .240                                       | 4.32       | .62701                                       | .4078                                      | 7.34       | .63750                                       |
| 1/2               | .840                               | 14                         | .07143                    | .75843                                                                | .320                                       | 4.48       | .77843                                       | .5337                                      | 7.47       | .79179                                       |
| 3/4               | 1.050                              | 14                         | .07143                    | .96768                                                                | .339                                       | 4.75       | .98887                                       | .5457                                      | 7.64       | 1.00179                                      |
| 1                 | 1.315                              | 11 1/2                     | .08696                    | 1.21363                                                               | .400                                       | 4.60       | 1.23863                                      | .6828                                      | 7.85       | 1.25630                                      |
| 1 1/4             | 1.660                              | 11 1/2                     | .08696                    | 1.55713                                                               | .420                                       | 4.83       | 1.58338                                      | .7068                                      | 8.13       | 1.60130                                      |
| 1 1/2             | 1.900                              | 11 1/2                     | .08696                    | 1.79609                                                               | .420                                       | 4.83       | 1.82234                                      | .7235                                      | 8.32       | 1.84130                                      |
| 2                 | 2.375                              | 11 1/2                     | .08696                    | 2.26902                                                               | .436                                       | 5.01       | 2.26627                                      | .7365                                      | 8.70       | 2.31630                                      |
| 2 1/2             | 2.875                              | 8                          | .12500                    | 2.71953                                                               | .682                                       | 5.46       | 2.76216                                      | 1.1375                                     | 9.10       | 2.79062                                      |
| 3                 | 3.500                              | 8                          | .12500                    | 3.34062                                                               | .766                                       | 6.13       | 3.38850                                      | 1.2000                                     | 9.60       | 3.41562                                      |
| 3 1/2             | 4.000                              | 8                          | .12500                    | 3.83750                                                               | .821                                       | 6.57       | 3.88881                                      | 1.2500                                     | 10.00      | 3.91562                                      |
| 4                 | 4.500                              | 8                          | .12500                    | 4.33438                                                               | .844                                       | 6.75       | 4.38712                                      | 1.3000                                     | 10.40      | 4.41562                                      |
| 5                 | 5.563                              | 8                          | .12500                    | 5.39073                                                               | .937                                       | 7.50       | 5.44929                                      | 1.4063                                     | 11.25      | 5.47862                                      |
| 6                 | 6.625                              | 8                          | .12500                    | 6.44609                                                               | .958                                       | 7.66       | 6.50597                                      | 1.5125                                     | 12.10      | 6.54062                                      |
| 8                 | 8.625                              | 8                          | .12500                    | 8.43359                                                               | 1.063                                      | 8.50       | 8.50003                                      | 1.7125                                     | 13.70      | 8.54062                                      |
| 10                | 10.750                             | 8                          | .12500                    | 10.54531                                                              | 1.210                                      | 9.68       | 10.62094                                     | 1.9250                                     | 15.40      | 10.66562                                     |
| 12                | 12.750                             | 8                          | .12500                    | 12.53281                                                              | 1.360                                      | 10.88      | 12.61781                                     | 2.1250                                     | 17.00      | 12.66562                                     |
| 14 OD             | 14.000                             | 8                          | .12500                    | 13.77500                                                              | 1.562                                      | 12.50      | 13.87262                                     | 2.2500                                     | 18.90      | 13.91562                                     |
| 16 OD             | 16.000                             | 8                          | .12500                    | 15.76250                                                              | 1.812                                      | 14.50      | 15.87575                                     | 2.4500                                     | 19.60      | 15.91562                                     |
| 18 OD             | 18.000                             | 8                          | .12500                    | 17.75000                                                              | 2.000                                      | 16.00      | 17.87500                                     | 2.6500                                     | 21.20      | 17.91562                                     |
| 20 OD             | 20.000                             | 8                          | .12500                    | 19.73750                                                              | 2.125                                      | 17.00      | 19.87031                                     | 2.8500                                     | 22.80      | 19.91562                                     |
| 24 OD             | 24.000                             | 8                          | .12500                    | 23.71250                                                              | 2.375                                      | 19.00      | 23.86094                                     | 3.2500                                     | 26.00      | 23.91562                                     |

<sup>a</sup> The basic dimensions of the American Standard taper pipe thread are given in inches to four or five decimal places. While this implies a greater degree of precision than is ordinarily attained, these dimensions are the basis of gage dimensions and are so expressed for the purpose of eliminating errors in computations.

<sup>b</sup> Also length of thin ring gage and length from gaging notch to small end of plug gage.

<sup>c</sup> Also pitch diameter at gaging notch (handtight plane).

<sup>d</sup> Also length of plug gage.

TABLE VII.2.—Basic dimensions of American Standard taper pipe threads, NPT • Continued

| Nominal pipe size    | Wrench makeup length for internal thread |         |                 | Vanish threads, V |         | Over-all length external thread, $L_4$ | Nominal perfect external threads |          | Height of thread, $h$ | Increase in diameter per thread, $0.0625/n$ | Basic minor diameter at small end of pipe, $K_2$ |
|----------------------|------------------------------------------|---------|-----------------|-------------------|---------|----------------------------------------|----------------------------------|----------|-----------------------|---------------------------------------------|--------------------------------------------------|
|                      | Length, $L_1$                            |         | Diameter, $E_1$ |                   |         |                                        |                                  |          |                       |                                             |                                                  |
| 1                    | 12                                       | 13      | 14              | 15                | 16      | 17                                     | 18                               | 19       | 20                    | 21                                          | 22                                               |
| in.                  | in.                                      | threads | in.             | in.               | threads | in.                                    | in.                              | in.      | in.                   | in.                                         | in.                                              |
| $\frac{1}{8}$ .....  | 0.1111                                   | 3       | 0.26424         | 0.1285            | 3.47    | 0.3896                                 | 0.1870                           | 0.28287  | 0.02963               | 0.00231                                     | 0.2416                                           |
| $\frac{1}{4}$ .....  | .1111                                    | 3       | .35656          | .1285             | 3.47    | .3924                                  | .1898                            | .37537   | .02963                | .00231                                      | .3339                                            |
| $\frac{3}{8}$ .....  | .1667                                    | 3       | .46697          | .1928             | 3.47    | .5046                                  | .2907                            | .49556   | .04444                | .00347                                      | .4329                                            |
| $\frac{1}{2}$ .....  | .1667                                    | 3       | .60160          | .1928             | 3.47    | .6006                                  | .2967                            | .63056   | .04444                | .00347                                      | .5676                                            |
| $\frac{3}{4}$ .....  | .2143                                    | 3       | .74504          | .2478             | 3.47    | .7815                                  | .3909                            | .78286   | .05714                | .00446                                      | .7013                                            |
| $\frac{1}{2}$ .....  | .2143                                    | 3       | .95429          | .2478             | 3.47    | .7935                                  | .4029                            | .99286   | .05714                | .00446                                      | .9105                                            |
| 1.....               | .2609                                    | 3       | 1.19733         | .3017             | 3.47    | .9845                                  | .5089                            | 1.24543  | .06957                | .00543                                      | 1.1441                                           |
| $1\frac{1}{4}$ ..... | .2609                                    | 3       | 1.54083         | .3017             | 3.47    | 1.0085                                 | .5329                            | 1.59043  | .06957                | .00543                                      | 1.4876                                           |
| $1\frac{1}{2}$ ..... | .2609                                    | 3       | 1.77978         | .3017             | 3.47    | 1.0252                                 | .5496                            | 1.83043  | .06957                | .00543                                      | 1.7265                                           |
| 2.....               | .2609                                    | 3       | 2.25272         | .3017             | 3.47    | 1.0582                                 | .5826                            | 2.30543  | .06957                | .00543                                      | 2.1995                                           |
| $2\frac{1}{2}$ ..... | .2500*                                   | 2       | 2.70391         | .4337             | 3.47    | 1.5712                                 | .8875                            | 2.77500  | .10000                | .00781                                      | 2.6195                                           |
| 3.....               | .2500*                                   | 2       | 3.32500         | .4337             | 3.47    | 1.6337                                 | .9500                            | 3.40000  | .10000                | .00781                                      | 3.2406                                           |
| $3\frac{1}{2}$ ..... | .2500                                    | 2       | 3.82188         | .4337             | 3.47    | 1.6837                                 | 1.0000                           | 3.90000  | .10000                | .00781                                      | 3.7375                                           |
| 4.....               | .2500                                    | 2       | 4.31875         | .4337             | 3.47    | 1.7337                                 | 1.0500                           | 4.40000  | .10000                | .00781                                      | 4.2344                                           |
| 5.....               | .2500                                    | 2       | 5.37511         | .4337             | 3.47    | 1.8400                                 | 1.1563                           | 5.46300  | .10000                | .00781                                      | 5.2907                                           |
| 6.....               | .2500                                    | 2       | 6.43047         | .4337             | 3.47    | 1.9462                                 | 1.2625                           | 6.52500  | .10000                | .00781                                      | 6.3461                                           |
| 8.....               | .2500                                    | 2       | 8.41797         | .4337             | 3.47    | 2.1462                                 | 1.4625                           | 8.52500  | .10000                | .00781                                      | 8.3336                                           |
| 10.....              | .2500                                    | 2       | 10.52969        | .4337             | 3.47    | 2.3587                                 | 1.6750                           | 10.65000 | .10000                | .00781                                      | 10.4453                                          |
| 12.....              | .2500                                    | 2       | 12.51719        | .4337             | 3.47    | 2.5587                                 | 1.8750                           | 12.65000 | .10000                | .00781                                      | 12.4328                                          |
| 14 OD.....           | .2500                                    | 2       | 13.75938        | .4337             | 3.47    | 2.6837                                 | 2.0000                           | 13.90000 | .10000                | .00781                                      | 13.6750                                          |
| 16 OD.....           | .2500                                    | 2       | 15.74688        | .4337             | 3.47    | 2.8837                                 | 2.2000                           | 15.90000 | .10000                | .00781                                      | 15.6625                                          |
| 18 OD.....           | .2500                                    | 2       | 17.73438        | .4337             | 3.47    | 3.0837                                 | 2.4000                           | 17.90000 | .10000                | .00781                                      | 17.6500                                          |
| 20 OD.....           | .2500                                    | 2       | 19.72188        | .4337             | 3.47    | 3.2837                                 | 2.6000                           | 19.90000 | .10000                | .00781                                      | 19.6375                                          |
| 24 OD.....           | .2500                                    | 2       | 23.69688        | .4337             | 3.47    | 3.6837                                 | 3.0000                           | 23.90000 | .10000                | .00781                                      | 23.6125                                          |

\* The basic dimensions of the American Standard taper pipe thread are given in inches to four or five decimal places. While this implies a greater degree of precision than is ordinarily attained, these dimensions are the basis of the dimensions and are so expressed for the purpose of eliminating errors in computations.

\* The length  $L_1$  from the end of the pipe determines the plane beyond which the thread form is imperfect at the crest. The next two threads are

perfect at the root. At this plane the cone formed by the crests of the thread intersects the cylinder forming the external surface of the pipe.  $L_1 = L_2 - 2p$ . / Given as information for use in selecting tap drills. (See appendix 7, p. 102.)

\* Military Specification MIL-P-7105 gives the wrench makeup as three threads for 3 in. and smaller. The  $E_2$  dimensions are: Size  $2\frac{1}{2}$  in., 2.69609 and size 3 in., 3.31719.

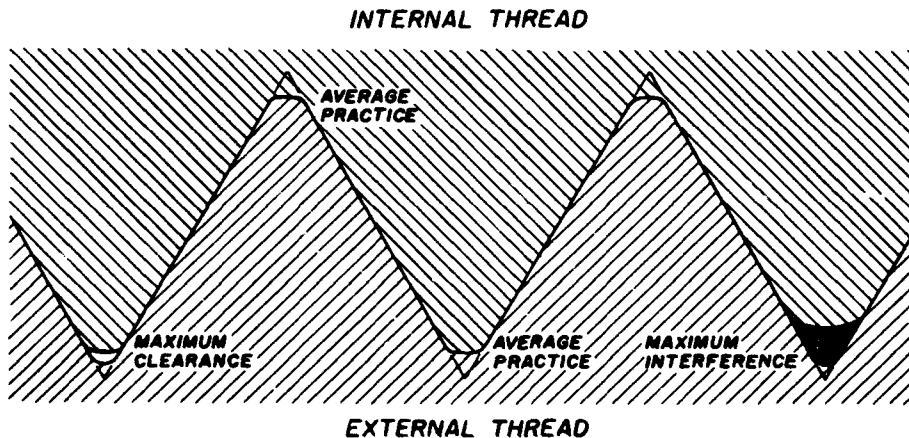


FIGURE VII.2.—American Standard taper pipe threads for pressure-tight joints, NPT.

(When threaded joints are made up wrench tight with lubricant or sealer, it is intended that the flanks shall be in contact.)

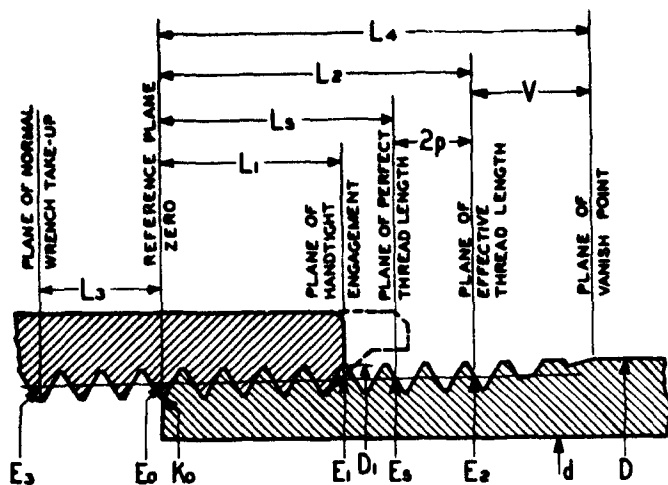


FIGURE VII.3.—American Standard taper pipe thread notation.

TABLE VII.3.—Tolerances on taper, lead, and angle of pipe threads of steel products and all pipe of steel, wrought-iron, or brass (exclusive of butt-weld pipe)

| Nominal pipe size  | Threads per inch | Taper on pitch line |        | Lead in length of effective threads | 60° angle of threads |
|--------------------|------------------|---------------------|--------|-------------------------------------|----------------------|
|                    |                  | Max                 | Min    |                                     |                      |
| 1                  | 2                | 3                   | 4      | 5                                   | 6                    |
| in.                |                  | in./ft              | in./ft | in. ±                               | deg. ±               |
| 1/8, 3/8           | 27               | 3/8                 | 1 1/16 | 0.003                               | 2 1/2                |
| 1/4, 3/4           | 18               | 3/8                 | 1 1/16 | 0.003                               | 2                    |
| 1/2, 3/2           | 14               | 3/8                 | 1 1/16 | 0.003                               | 2                    |
| 1, 1 1/4, 1 1/2, 2 | 11 1/2           | 3/8                 | 1 1/16 | 0.003                               | 1 1/2                |
| 2 1/2 and larger   | 8                | 3/8                 | 1 1/16 | 0.003                               | 1 1/2                |

\* The tolerance on lead shall be  $\pm 0.003$  in./in. on any size threaded to an effective thread length greater than 1 in.

NOTE.—For tolerances on depth of thread see table VII.1, and for tolerances on pitch diameter see par. 8, p. 4.

The limits specified in this table are intended to serve as a guide for establishing limits of the thread elements of taps, dies, and thread chasers. These limits may be required on product threads.

#### 4. SPECIFICATIONS FOR INTERNAL STRAIGHT THREADS IN PIPE COUPLINGS, NPSC

Threads in pipe couplings made in accordance with these specifications are straight (parallel) threads of the same thread form as the American Standard taper pipe thread specified in par. 1 and 2, p. 2. They are used to form pressure-tight joints when assembled with an American Standard external taper pipe thread and made up with lubricant or sealer. The resulting joints are recommended for comparatively low pressures only. The American Standard Coupling Straight Pipe Thread is designated as shown in the following example:

1/8—27NPSC

The dimensions and pitch diameter tolerances are specified in table VII.4. The pitch diameter tolerances correspond to one and one-half turns large or small of the standard taper pipe thread. The major and minor diameters vary with the pitch diameter, as the American Standard pipe thread form is maintained\* within the truncation tolerances shown in table VII.1, p. 4.

TABLE VII.4.—Dimensions of internal straight threads in pipe couplings (pressure-tight joints with lubricant or sealer), NPSC

| Nominal pipe size | Threads per inch | Minor diameter | Pitch diameter * |        |
|-------------------|------------------|----------------|------------------|--------|
|                   |                  | Min            | Min              | Max    |
| 1                 | 2                | 3              | 4                | 5      |
| in.               |                  | in.            | in.              | in.    |
| 1/8               | 27               | 0.340          | 0.3701           | 0.3771 |
| 1/4               | 18               | 0.442          | 0.4864           | 0.4968 |
| 3/8               | 18               | 0.577          | 0.6218           | 0.6322 |
| 1/2               | 14               | 0.715          | 0.7717           | 0.7851 |
| 3/4               | 14               | 0.925          | 0.9822           | 0.9956 |
| 1                 | 11 1/2           | 1.161          | 1.2305           | 1.2468 |
| 1 1/4             | 11 1/2           | 1.806          | 1.8752           | 1.8915 |
| 1 1/2             | 11 1/2           | 1.745          | 1.8142           | 1.8305 |
| 2                 | 11 1/2           | 2.219          | 2.2881           | 2.3044 |
| 2 1/2             | 8                | 2.650          | 2.7504           | 2.7739 |
| 3                 | 8                | 3.277          | 3.3768           | 3.4002 |
| 3 1/2             | 8                | 3.777          | 3.8771           | 3.9005 |
| 4                 | 8                | 4.275          | 4.3754           | 4.3988 |

\* As the American Standard pipe thread form is maintained the major and the minor diameters of the internal thread vary with the pitch diameter.

\* Attention is called to the fact that the actual pitch diameter of the straight tapped hole will be slightly smaller than the values given when gaged with a taper plug gage as specified in par. 8(c), p. 18.

#### 5. SPECIFICATIONS FOR RAILING JOINT TAPER PIPE THREADS, NPTR

Railing joints require a rigid mechanical thread joint with external and internal taper threads.

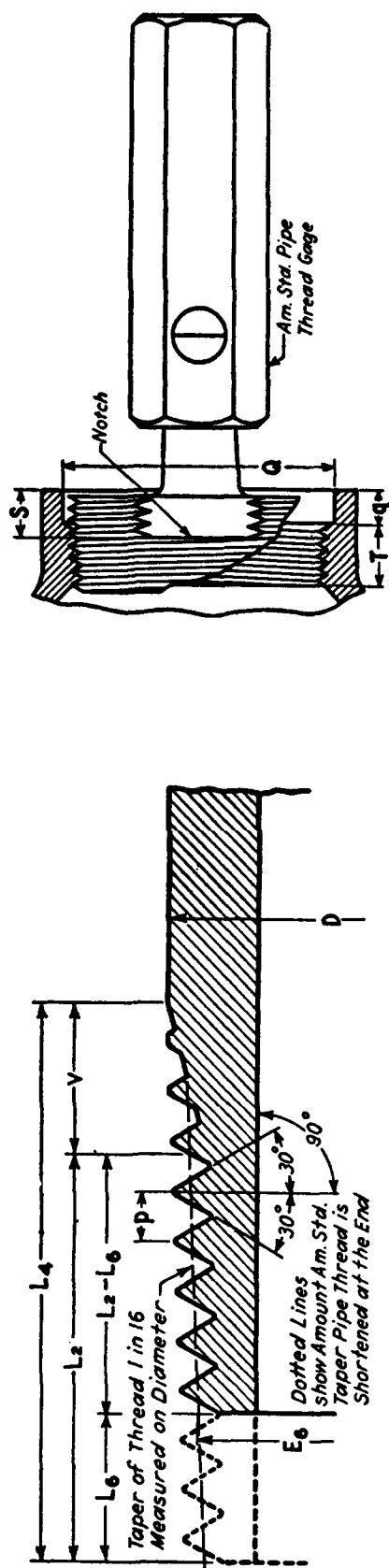
The external thread is basically the same as the American Standard taper pipe thread, except that it is shortened to permit the use of the larger end of the pipe thread (see fig. in table VII.5.). The dimensions of these external and internal threads are shown in table VII.5. A recess in the fitting provides a covering for the last scratch or imperfect threads on the pipe.

The form of thread is the same as the form of the American Standard taper pipe thread shown in figure VII.1. An NPTR thread is designated as shown in the following example:

1/2—14NPTR

The gaging of these threads is specified in table VII.5. The maximum allowable variation in the external thread is no turns large and one turn small. The maximum allowable variation in the internal thread is one turn large, no turns small.

TABLE VII.5.—Dimensions of external and internal taper pipe threads for railing joints (mechanical joints), NPTR.\*



| Nominal<br>pipe size | Outside<br>diam-<br>eter of<br>pipe, $D$ | Threads<br>per inch | Height<br>of<br>thread | Pitch di-<br>ameter<br>at end of<br>external<br>thread, $E_6$ | Shortening of<br>Am. Std.<br>pipe thread,<br>$L_4$ |     | Length of<br>effective<br>thread, $L_2-L_6$ |      | Total length<br>of external<br>thread, max,<br>$L_2-L_6$ |      | Imperfect<br>threads<br>due to<br>chamber of<br>die, max, $V$ |                | Depth of<br>recess in<br>fitting, $q$<br>min, $q$ | Diameter<br>of recess in<br>fitting,<br>min, $Q$ | Length,<br>min, $T$ | Distance gage $s$<br>notch comes<br>below face of<br>fitting, $S$ |     |
|----------------------|------------------------------------------|---------------------|------------------------|---------------------------------------------------------------|----------------------------------------------------|-----|---------------------------------------------|------|----------------------------------------------------------|------|---------------------------------------------------------------|----------------|---------------------------------------------------|--------------------------------------------------|---------------------|-------------------------------------------------------------------|-----|
|                      |                                          |                     |                        |                                                               | in.                                                | ths | in.                                         | ths  | in.                                                      | ths  | in.                                                           | ths            |                                                   |                                                  |                     | in.                                                               | ths |
| 1                    |                                          | 3                   | 4                      | 5                                                             | 6                                                  | 7   | 8                                           | 9    | 10                                                       | 11   | 12                                                            | 13             | 14                                                | 15                                               | 16                  | 17                                                                | 18  |
|                      | in.                                      |                     | in.                    | in.                                                           | in.                                                | ths | in.                                         | ths  | in.                                                      | ths  | in.                                                           | ths            | in.                                               | in.                                              | in.                 | in.                                                               | ths |
| $\frac{1}{2}$        | 0.840                                    | 14                  | 0.0571                 | 0.7718                                                        | 0.214                                              | 3   | 0.320                                       | 4.47 | 0.499                                                    | 6.08 | 0.179                                                         | $2\frac{1}{2}$ | 0.18                                              | 0.86                                             | 0.25                | 0.286                                                             | 4   |
| $\frac{3}{4}$        | 1.050                                    | 14                  | 0.0571                 | 0.9811                                                        | 0.214                                              | 3   | 0.332                                       | 4.64 | 0.510                                                    | 7.15 | 0.179                                                         | $2\frac{1}{2}$ | 0.18                                              | 1.07                                             | 0.25                | 0.286                                                             | 4   |
| 1                    | 1.315                                    | $11\frac{1}{2}$     | 0.0696                 | 1.2209                                                        | 0.261                                              | 3   | 0.422                                       | 4.85 | 0.639                                                    | 7.35 | 0.217                                                         | $2\frac{1}{2}$ | 0.22                                              | 1.34                                             | 0.30                | 0.348                                                             | 4   |
| $1\frac{1}{4}$       | 1.660                                    | $11\frac{1}{2}$     | 0.0696                 | 1.5734                                                        | 0.261                                              | 3   | 0.446                                       | 5.13 | 0.707                                                    | 8.13 | 0.261                                                         | 3              | 0.26                                              | 1.68                                             | 0.39                | 0.348                                                             | 4   |
| $1\frac{1}{2}$       | 1.900                                    | $11\frac{1}{2}$     | 0.0696                 | 1.8124                                                        | 0.261                                              | 3   | 0.463                                       | 5.32 | 0.724                                                    | 8.33 | 0.261                                                         | 3              | 0.26                                              | 1.92                                             | 0.43                | 0.348                                                             | 4   |
| 2                    | 2.375                                    | $11\frac{1}{2}$     | 0.0696                 | 2.2853                                                        | 0.261                                              | 3   | 0.496                                       | 5.70 | 0.757                                                    | 8.70 | 0.261                                                         | 3              | 0.26                                              | 2.40                                             | 0.43                | 0.348                                                             | 4   |
| $2\frac{1}{2}$       | 2.875                                    | 8                   | 0.1000                 | 2.7508                                                        | 0.500                                              | 4   | 0.638                                       | 5.10 | 1.013                                                    | 8.10 | 0.375                                                         | 3              | 0.38                                              | 2.90                                             | 0.63                | 0.625                                                             | 5   |
| 3                    | 3.500                                    | 8                   | 0.1000                 | 3.3719                                                        | 0.500                                              | 4   | 0.700                                       | 5.60 | 1.075                                                    | 8.60 | 0.375                                                         | 3              | 0.38                                              | 3.53                                             | 0.63                | 0.625                                                             | 5   |
| $3\frac{1}{2}$       | 4.000                                    | 8                   | 0.1000                 | 3.8688                                                        | 0.500                                              | 4   | 0.750                                       | 6.00 | 1.125                                                    | 9.00 | 0.375                                                         | 3              | 0.38                                              | 4.04                                             | 0.63                | 0.625                                                             | 5   |
| 4                    | 4.500                                    | 8                   | 0.1000                 | 4.3656                                                        | 0.500                                              | 4   | 0.800                                       | 6.40 | 1.175                                                    | 9.40 | 0.375                                                         | 3              | 0.38                                              | 4.54                                             | 0.63                | 0.625                                                             | 5   |

\* These dimensions agree with those developed by the Manufacturers Standardization Society of the Valve and Fittings Industry. Thread lengths are specified to three decimal places for convenience.

† American Standard taper pipe thread plug gage (see par. 8, p. 11).

## 6. SPECIFICATIONS FOR STRAIGHT PIPE THREADS FOR MECHANICAL JOINTS,<sup>1</sup> NPSM, NPSL, NPSH

While external and internal taper pipe threads are recommended for pipe joints in practically every service, there are certain types of joints where straight pipe threads are used to advantage. Three of these straight pipe thread joints are covered by this handbook, all of which are based on the pitch diameter of the American Standard taper

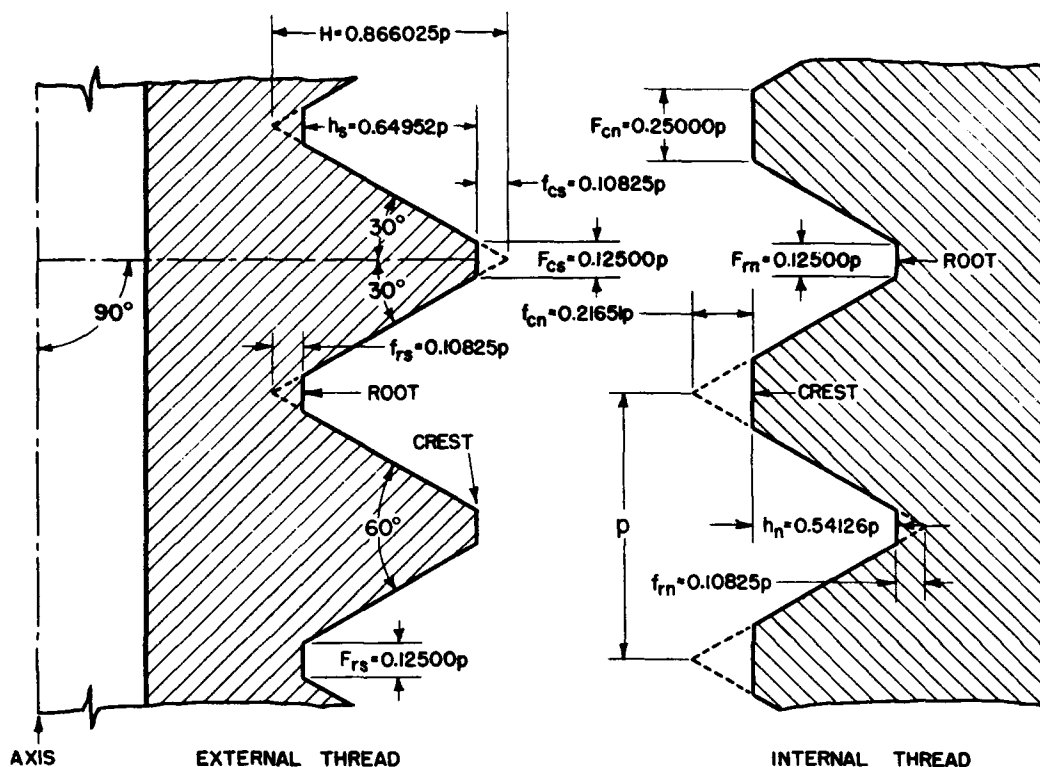
pipe thread at the gaging notch (Dimension  $E_1$  of table VII.2) but have various truncations at crest and root as described below. These three types of joints are as follows:

Type 1. Free-fitting mechanical joints for fixtures, table VII.6, both external and internal, NPSM.

Type 2. Loose-fitting mechanical joints with locknuts, table VII.7, both external and internal, NPSL.

<sup>1</sup> See footnote 2, p. 1.

TABLE VII.6.—Dimensions of external and internal straight pipe threads for mechanical joints (free-fitting), NPSM



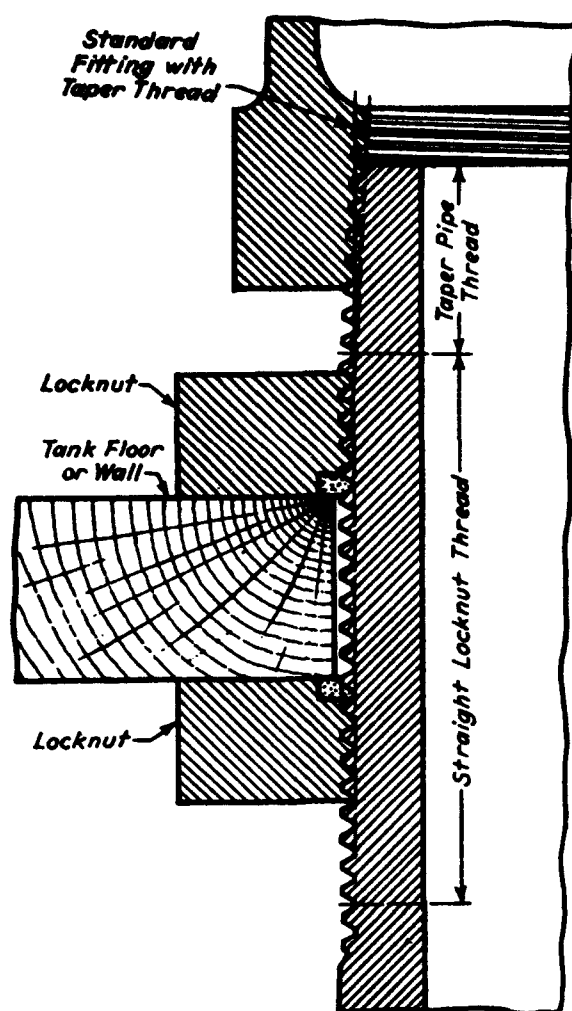
| Nominal pipe size | Threads per inch | External thread, class 2A |                |       |                |        | Internal thread, class 2B |       |                |        |
|-------------------|------------------|---------------------------|----------------|-------|----------------|--------|---------------------------|-------|----------------|--------|
|                   |                  | Allowance                 | Major diameter |       | Pitch diameter |        | Minor diameter            |       | Pitch diameter |        |
|                   |                  |                           | Max            | Min   | Max            | Min    | Min                       | Max   | Min *          | Max    |
| 1                 | 2                | 3                         | 4              | 5     | 6              | 7      | 8                         | 9     | 10             | 11     |
| in.               |                  | in.                       | in.            | in.   | in.            | in.    | in.                       | in.   | in.            | in.    |
| 1/16              | 27               | 0.0011                    | 0.397          | 0.390 | 0.3725         | 0.3689 | 0.358                     | 0.364 | 0.3736         | 0.3783 |
| 1/8               | 18               | .0013                     | .526           | .517  | .4903          | .4859  | .468                      | .481  | .4916          | .4974  |
| 3/16              | 18               | .0014                     | .662           | .653  | .6256          | .6211  | .603                      | .612  | .6270          | .6329  |
| 1/4               | 14               | .0015                     | .823           | .813  | .7769          | .7718  | .747                      | .759  | .7784          | .7851  |
| 5/16              | 14               | .0016                     | 1.034          | 1.024 | .9873          | .9820  | .958                      | .970  | .9889          | .9958  |
| 3/8               | 1 1/2            | .0017                     | 1.293          | 1.281 | 1.2369         | 1.2311 | 1.201                     | 1.211 | 1.2386         | 1.2462 |
| 1/2               | 1 1/2            | .0018                     | 1.638          | 1.626 | 1.5816         | 1.5756 | 1.546                     | 1.555 | 1.5834         | 1.5912 |
| 5/8               | 1 1/2            | .0018                     | 1.877          | 1.865 | 1.8205         | 1.8144 | 1.785                     | 1.794 | 1.8223         | 1.8302 |
| 3/4               | 1 1/2            | .0019                     | 2.351          | 2.339 | 2.2944         | 2.2882 | 2.259                     | 2.268 | 2.2963         | 2.3044 |
| 7/8               | 8                | .0022                     | 2.841          | 2.826 | 2.7600         | 2.7526 | 2.708                     | 2.727 | 2.7622         | 2.7720 |
| 1                 | 8                | .0023                     | 3.467          | 3.452 | 3.3862         | 3.3786 | 3.334                     | 3.353 | 3.3885         | 3.3984 |
| 1 1/8             | 8                | .0023                     | 3.968          | 3.953 | 3.8865         | 3.8788 | 3.835                     | 3.848 | 3.8893         | 3.8988 |
| 1 1/4             | 8                | .0023                     | 4.466          | 4.451 | 4.3848         | 4.3771 | 4.333                     | 4.346 | 4.3871         | 4.3971 |
| 1 3/8             | 8                | .0024                     | 5.528          | 5.513 | 5.4469         | 5.4390 | 5.395                     | 5.408 | 5.4493         | 5.4598 |
| 1 1/2             | 8                | .0024                     | 6.585          | 6.570 | 6.5036         | 6.4955 | 6.452                     | 6.464 | 6.5060         | 6.5165 |

\* Column 10 is the same as the pitch diameter at the end of internal thread,  $E_1$ , basic (see table VII.2, col. 8).

NOTE: The minor diameters of external threads and major diameters of internal threads are those as produced by commercial straight pipe dies and commercial ground straight pipe taps.

The major diameter of the external thread has been calculated on the basis of a truncation of  $0.10825p$ , and the minor diameter of the internal thread has been calculated on the basis of a truncation of  $0.21651p$  to provide no interference at crest and root when product is gaged with gages made in accordance with par. 8(d), p. 18.

TABLE VII.7.—Dimensions of external and internal straight pipe threads for locknut connections (loose-fitting mechanical joints), NPSL



| Nominal pipe size | Threads per inch | External threads |                          |                |         | Internal threads         |                |         |
|-------------------|------------------|------------------|--------------------------|----------------|---------|--------------------------|----------------|---------|
|                   |                  | Allowance        | Maximum * major diameter | Pitch diameter |         | Minimum * minor diameter | Pitch diameter |         |
|                   |                  |                  |                          | Max            | Min     |                          | Min            | Max     |
| 1                 | 2                | 3                | 4                        | 5              | 6       | 7                        | 8              | 9       |
| in.               |                  | in.              | in.                      | in.            | in.     | in.                      | in.            | in.     |
| 1/4               | 27               | 0.0023           | 0.409                    | 0.3840         | 0.3805  | 0.362                    | 0.3633         | 0.3896  |
| 1/4               | 18               | .0035            | .541                     | .5028          | .4986   | .470                     | .5073          | .5125   |
| 1/2               | 18               | .0035            | .678                     | .6409          | .6357   | .607                     | .6444          | .6496   |
| 3/4               | 14               | .0045            | .844                     | .7963          | .7896   | .753                     | .8008          | .8075   |
| 1                 | 14               | .0045            | 1.054                    | 1.0057         | 1.0000  | .964                     | 1.0112         | 1.0179  |
| 1 1/4             | 11 1/2           | .0054            | 1.318                    | 1.2604         | 1.2523  | 1.206                    | 1.2658         | 1.2739  |
| 1 1/2             | 11 1/2           | .0055            | 1.663                    | 1.6051         | 1.5970  | 1.553                    | 1.6106         | 1.6187  |
| 2                 | 11 1/2           | .0054            | 1.902                    | 1.8441         | 1.8360  | 1.792                    | 1.8495         | 1.8576  |
| 2 1/2             | 11 1/2           | .0054            | 2.876                    | 2.8180         | 2.8099  | 2.765                    | 2.8234         | 2.8315  |
| 3                 | 8                | .0078            | 2.877                    | 2.7984         | 2.7817  | 2.718                    | 2.8012         | 2.8129  |
| 3 1/2             | 8                | .0078            | 3.503                    | 3.4196         | 3.4061  | 3.344                    | 3.4276         | 3.4393  |
| 4                 | 8                | .0078            | 4.003                    | 3.9201         | 3.9064  | 3.845                    | 3.9279         | 3.9396  |
| 5                 | 8                | .0078            | 4.502                    | 4.4184         | 4.4057  | 4.343                    | 4.4262         | 4.4379  |
| 6                 | 8                | .0079            | 5.564                    | 5.4805         | 5.4688  | 5.405                    | 5.4884         | 5.5001  |
| 8                 | 8                | .0078            | 6.630                    | 6.5372         | 6.5255  | 6.462                    | 6.5450         | 6.5567  |
| 10                | 8                | .0078            | 8.615                    | 8.5313         | 8.5196  | 8.456                    | 8.5391         | 8.5508  |
| 12                | 8                | .0078            | 10.735                   | 10.6522        | 10.6405 | 10.577                   | 10.6600        | 10.6717 |
| 14                | 8                | .0078            | 12.732                   | 12.6491        | 12.6374 | 12.574                   | 12.6569        | 12.6686 |

\* As the American Standard straight pipe thread form of thread is maintained the major and the minor diameters of the internal thread and the minor diameter of the external thread vary with the pitch diameter. The major diameter of the external thread is usually determined by the diameter of the pipe. These theoretical diameters result from adding the depth of the truncated thread ( $0.666025 \times p$ ) to the maximum pitch diameters in column 5, and it should be understood that commercial pipe will not always have these maximum major diameters.

The locknut thread is established on the basis of retaining the greatest possible amount of metal thickness between the bottom of the thread and the inside of the pipe.

In order that a locknut may fit loosely on the externally threaded part, an allowance equal to the "increase in pitch diameter per turn" is provided with a tolerance of 1 1/4 turns for both external and internal thread (see table 7.8, p. 107).

**Type 3. Loose-fitting mechanical joints for hose couplings, NPSH.<sup>2</sup>**

(a) **Thread designations.**—The above types of straight pipe threads for mechanical joints are designated by specifying in sequence the nominal size, number of threads per inch, form (straight) and symbol of the thread series, as follows:

$\frac{1}{8}$ —27NPSM  
 $\frac{1}{8}$ —27NPSL  
 1—11  $\frac{1}{2}$ NPSH

(b) **Pitch and flank angle.**—The pitch and flank angle are the same as the corresponding dimensions of the taper pipe thread described in pars. 1 and 2, p. 2.

(c) **Diameter of thread.**—The basic pitch diameter for both the external and internal straight pipe threads is equal to the pitch diameter of the American Standard taper pipe thread at the gaging notch (dimension  $E_1$  of table VII.2), which is the same as the large end of the internal taper pipe thread.

**1. FREE-FITTING MECHANICAL JOINTS FOR FIXTURES, NPSM.**—Standard iron, steel, and brass pipe are often used for special applications where there are no internal pressures. Where straight thread joints are required for mechanical assemblies, straight pipe threads are often found more suited or convenient.

The dimensions of these threads, as given in table VII.6, are for pipe thread connections where the parts are assembled in the shop and where reasonably close fit of the mating parts is desired.

**2. LOOSE-FITTING MECHANICAL JOINTS WITH LOCKNUTS, NPSL.**—The American Standard external locknut thread is designed to produce a pipe thread having the largest diameter that it is possible to cut on standard pipe. Ordinarily straight internal threads are used with these straight external threads providing a loose fit. The dimensions of these threads are given in table VII.7. It will be noted that the maximum

major diameter of the external thread is slightly greater than the nominal outside diameter of the pipe. The normal manufacturer's variation in pipe diameter provides for this increase.

One application of the use of a taper pipe thread in combination with a locknut thread which has been in use for some time is that shown over table VII.7. It consists of the nipple threaded joint used to connect standpipes with the floor or wall of water supply tanks.

## 7. SPECIFICATIONS FOR UNIFIED SPECIAL STRAIGHT SCREW THREADS FOR USE ON THIN-WALL TUBING, UNS

UNS Unified special screw threads in the 27-thread series in sizes  $\frac{1}{8}$  to 1 in. are recommended for general use on thin-wall tubing. The class of thread is to be 2A and 2B.

The limits of size of these threads and the minimum length of complete thread are given in table VII.8.

**1. THREAD FORM.**—The Unified form of thread profile as specified in part I, section III, shall be used.

**2. THREAD DESIGNATION.**—The method to be used for the designation of the tubing thread is shown in the following example:

$\frac{1}{8}$ —27UNS—2A

**3. GAGES.**—The specifications for gages as presented in part I, section VI, apply to these threads. For identification, each gage shall be plainly marked with the thread designation in accordance with the previous paragraph.

## 8. GAGES AND GAGE TOLERANCES FOR AMERICAN STANDARD PIPE THREADS

**1. DESIGN OF GAGES.**—Gages for American Standard pipe threads are of the standard type or the limit type, as described below. Gages should conform to the designs recommended in Commercial Standard CS8 for pipe thread plug

TABLE VII.8.—Limits of size of Unified special screw threads for use on thin-wall tubing, UNS—2A, UNS—2B

| Nominal size and<br>threads per inch | External, 2A   |                |            |                |            |            |                        | Internal, 2B   |            |                |            |            |                   | Mini-<br>mum*<br>length of<br>complete<br>thread |
|--------------------------------------|----------------|----------------|------------|----------------|------------|------------|------------------------|----------------|------------|----------------|------------|------------|-------------------|--------------------------------------------------|
|                                      | Allow-<br>ance | Major diameter |            | Pitch diameter |            |            | Minor<br>diam-<br>eter | Minor diameter |            | Pitch diameter |            |            | Major<br>diameter |                                                  |
|                                      |                | Max            | Min        | Max            | Min        | Tolerance  |                        | Min            | Max        | Min            | Max        | Tolerance  | Min               |                                                  |
| 1                                    | 2              | 3              | 4          | 5              | 6          | 7          | 8                      | 9              | 10         | 11             | 12         | 13         | 14                | 15                                               |
|                                      | <i>in.</i>     | <i>in.</i>     | <i>in.</i> | <i>in.</i>     | <i>in.</i> | <i>in.</i> | <i>in.</i>             | <i>in.</i>     | <i>in.</i> | <i>in.</i>     | <i>in.</i> | <i>in.</i> | <i>in.</i>        | <i>in.</i>                                       |
| $\frac{1}{8}$ —27                    | .0010          | .2490          | .2423      | .2249          | .2214      | .0035      | .2036                  | .210           | .219       | .2259          | .2304      | .0045      | .2500             | .268                                             |
| $\frac{1}{4}$ —27                    | .0010          | .3115          | .3048      | .2874          | .2839      | .0035      | .2661                  | .272           | .281       | .2884          | .2929      | .0045      | .3125             | .289                                             |
| $\frac{3}{8}$ —27                    | .0011          | .3739          | .3672      | .3498          | .3462      | .0036      | .3285                  | .335           | .344       | .3509          | .3556      | .0047      | .3750             | .310                                             |
| $\frac{1}{2}$ —27                    | .0011          | .3889          | .3822      | .3648          | .3612      | .0036      | .3435                  | .350           | .359       | .3659          | .3706      | .0047      | .3900             | .315                                             |
| $\frac{5}{8}$ —27                    | .0011          | .4364          | .4297      | .4123          | .4087      | .0036      | .3910                  | .397           | .406       | .4134          | .4181      | .0047      | .4375             | .331                                             |
| $\frac{3}{4}$ —27                    | .0011          | .4989          | .4922      | .4748          | .4711      | .0037      | .4535                  | .460           | .469       | .4759          | .4807      | .0048      | .5000             | .352                                             |
| $\frac{7}{8}$ —27                    | .0011          | .5614          | .5547      | .5373          | .5336      | .0037      | .5160                  | .522           | .531       | .5384          | .5432      | .0048      | .5625             | .372                                             |
| 1—27                                 | .0011          | .6239          | .6172      | .5998          | .5960      | .0038      | .5785                  | .585           | .594       | .6009          | .6059      | .0050      | .6250             | .393                                             |
| $\frac{1}{8}$ —27                    | .0012          | .7488          | .7421      | .7247          | .7208      | .0039      | .7034                  | .710           | .719       | .7259          | .7310      | .0051      | .7500             | .435                                             |
| $\frac{1}{4}$ —27                    | .0012          | .8738          | .8671      | .8497          | .8458      | .0039      | .8284                  | .835           | .844       | .8509          | .8560      | .0051      | .8750             | .477                                             |
| 1—27                                 | .0012          | .9988          | .9921      | .9747          | .9707      | .0040      | .9534                  | .960           | .969       | .9759          | .9811      | .0052      | 1.0000            | .518                                             |

\* Based on formula: Minimum length of complete thread =  $\frac{1}{4}$  basic major diam (col. 14) + 0.185 in. (5 threads).

and ring gages 12 in. and smaller. Larger sizes should be of suitable design.

(a) *Standard type gages.*—A set of standard or basic type gages consists of a taper-threaded plug gage and a taper-threaded ring gage (see figs. VII.4 and VII.5). The plug gages are made to dimensions given in table VII.9 with a gaging notch located a distance  $L_1$  from the small end. The thin ring gages have a length equal to dimension  $L_1$ . These rings are fitted to the plugs, coming flush at the notch within tolerances as given in table VII.10. The roots of the threads on these gages should be undercut beyond the sharp V to a width of  $0.116p$ , to facilitate finishing. The crests are to be truncated an amount equal to  $0.100p$ , as illustrated in figure VII.5. In locating the basic gaging notch, the plane of the bottom of the notch should intersect the following thread flank or side at or near the pitch cone.

The ring gage shall be fitted to the plug so that, when assembled handtight, the gaging face will be flush with the small end of the plug, and the opposite face will be flush with the gaging notch on the plug within tolerances as given in table VII.10.

(b) *Limit type gages.*—There are occasions when it is desirable to check the maximum and minimum limits of taper threaded product directly with a limit working gage rather than with a standard basic working gage, which necessitates counting the turns by which the gage overtravels or fails to come up to the basic surface on the product. To meet this requirement, the design of limit gage shown in figure VII.6 has been developed as an alternative to the recognized standard type plug

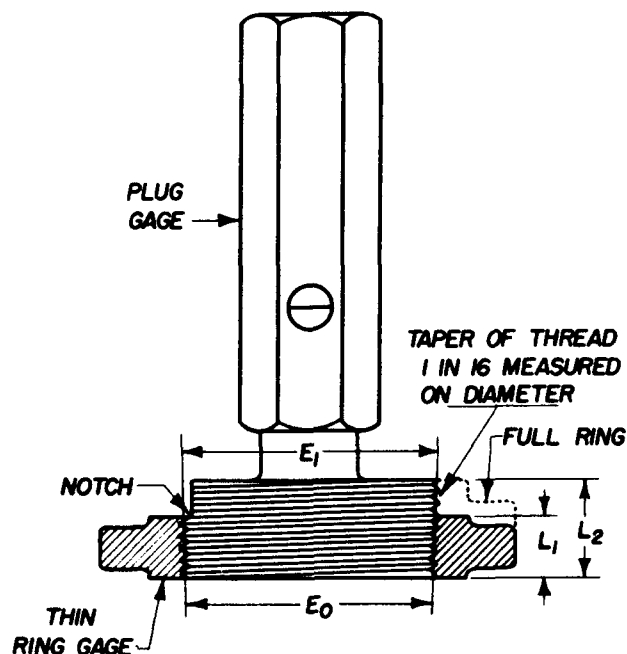


FIGURE VII.4.—American Standard taper pipe thread plug and thin ring gages.

NOTE.—The illustration shows standard design for sizes 2-inch and smaller; larger sizes are of slightly different designs.

and ring gages. These gages retain the basic notch on the plug together with the basic surface of the ring, and in addition include two notches, or steps, on both plug and ring, one the maximum and one the minimum. The retention of the basic step or notch is not essential but facilitates checking against the master and reference gages and also provides a convenient means of checking the maximum and minimum steps. The limit gage thread form, tolerances, etc., are the same as specified for the corresponding standard type gages.

(c) *Triroll gages.*—The triroll taper pipe thread gage, which functions in a manner similar to a taper thread ring gage of the limit type, has the additional advantage that the taper, thread angle, lead, and thread form may be examined visually by observing the contact between the gage rolls

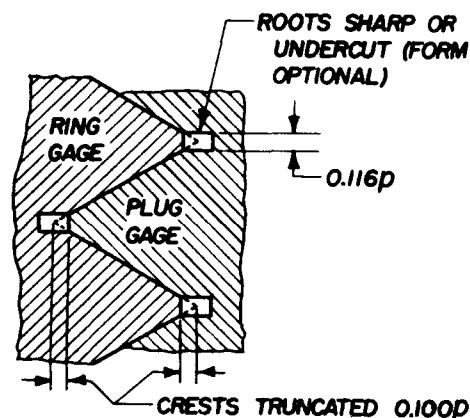


FIGURE VII.5.—Form of gage thread.

and the thread. A plain taper triroll gage may also be used to gage major diameter. This gage permits measurement of taper deviation which may be examined visually, or for all practical purposes be measured by inserting two thickness gages between the gage rolls and the major diameter of the product, one on each side, at the point of extreme gap. This gage has a flush-pin arrangement with basic, maximum, and minimum steps on the body which represent the thread size, and maximum and minimum steps on the flush pin corresponding to the limits on crest truncation.

2. *CLASSES OF GAGES.*—Gages of the following types may be used to completely cover gage requirements:

- 1—Master gages used to check reference gages.
- 2—Reference gages used to check working and inspection gages.
- 3—Inspection (or working) gages used for inspection in the final acceptance of threads and to check threads during manufacture.

(a) *Master gages.*—The set of master gages consists of two taper threaded plug gages and one thin ring gage (see figs. VII.4 and VII.5). The plug gages are made to dimensions given in table

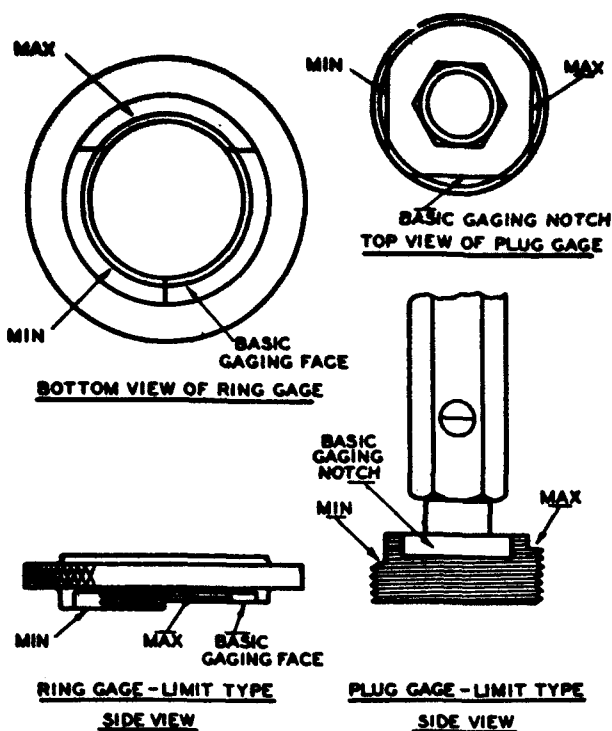


FIGURE VII.6.—Alternative form of taper pipe thread limit plug and thread ring gages.

VII.9. They are constructed of hardened steel with a gaging notch located a distance  $L_1$  (table VII.2) from the small end. The thin ring gages have a length equal to dimension  $L_1$ . These rings are fitted to the plugs coming flush at the notch. The roots of the threads on these gages should be undercut beyond the sharp V to facilitate finishing. The crests of one plug and the ring gage are truncated an amount equal to  $0.10p$  as illustrated in fig. VII.5. The crests of the other plug gage are truncated an amount equal to  $0.033p$  (see par. 3(a) below for tolerances). The set of master gages is primarily for the use of gage and tool manufacturers and for accurate comparison in checking reference gages.

The set of master gages should be made to the basic dimensions shown in table VII.9 as accurately as possible, but in no event exceeding the tolerances specified in table VII.10. Each master gage should in addition be accompanied by a record of the measurements of all elements of the thread.

(b) *Reference gages.*—The set of reference gages consists of taper threaded plug and ring gages (see figs. VII.4 and VII.5). They are identical in design and have the same thread form as the set of master gages. They are made of hardened steel to dimensions given in table VII.9 (see par. 3(b) below for tolerances). The reference gages are used primarily for checking working and inspection gages.

Each reference gage should be accompanied by a record of the decimal part of a turn that it varies large or small from the basic dimensions.

Caution—It must be understood that two gages

will not necessarily mate in accordance with the computed value that each may be off from basic.

(c) *Inspection (working) gages.*—The sets of inspection (working) gages consist of taper thread plug and ring gages of either the standard type or the limit type, and are used for checking the product. These gages are made of hardened steel to dimensions given in table VII.9 (see par. 3(b) below for tolerances).

It is to be noted that these gages are truncated at the crest an amount equal to  $0.1p$ , so that they bear only on the flanks of the thread. Thus, although they do not check the crest truncations specified in table VII.1, they are satisfactory for the inspection of the general run of product. When it is deemed necessary to determine whether or not such truncations are within the limits specified, or particularly to see that the maximum truncation is not exceeded, it is necessary to make further inspection. For this purpose optical projection, or MIL-P-7105 specification gages, may be used.

In locating the basic gaging notch the plane of the bottom of the notch should intersect the following thread flank or side at or near the pitch cone.

3. GAGE TOLERANCES.—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.

(a) *Master gage tolerances.*—The set of master gages should be made to the basic dimensions as accurately as possible but in no event exceeding the tolerances specified in table VII.10. Each master gage should in addition be accompanied by a record of the measurements of all elements of the thread (see par. 3(c) below).

(b) *Reference and inspection (working) gage tolerances.*—These gages should be made to the basic dimensions and should be within the tolerances for individual elements as specified in table VII.10. The maximum wear on inspection (working) gages shall not be more than the equivalent of one-half turn from the basic dimensions.

(c) *Relation of lead and angle deviations to pitch diameter tolerances of gages.*—When it is necessary to compute from measurements the decimal part of a turn that a gage varies from the basic dimensions which is required for master and reference gages, tables VII.11 and VII.12 should be used. Table VII.11 gives the correction in diameter for angle deviations and table VII.12 gives the correction in diameter for lead deviations. 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 or not the lead or angle deviations are plus or minus.

The diameter equivalent for lead and angle deviations plus the pitch diameter deviations multiplied by 16 gives the longitudinal variation from basic at the gaging notch. This longitudinal vari-

ation divided by the pitch equals the decimal part of a turn that the gage varies from basic at the gaging notch.

4. GAGING EXTERNAL TAPER THREADS.—In gaging external taper threads, the ring gage, figure VII.7, is screwed handtight on the pipe or external thread. The thread is within the permissible tolerance when the gaging face of the working or inspection ring gage is not more than 1 turn, large or small, from being flush with the end of the thread, as indicated in figure VII.7, allowance being made for any variation in the gage from basic dimensions.

5. GAGING INTERNAL TAPER THREADS.—In gaging internal taper threads, the plug gage, figures VII.4 and VII.6, is screwed handtight into the fitting or coupling. The thread is within the permissible tolerance when the gaging notch of the working or inspection plug gage is not more than 1 turn, large or small, from being flush with the end of the thread, as indicated in figure VII.8, allowance being made for any variation in the gage from basic dimensions.

6. GAGING CHAMFERED, COUNTERSUNK, OR RECESSED THREADS.—When the internal thread is chamfered, countersunk, or recessed, the notch

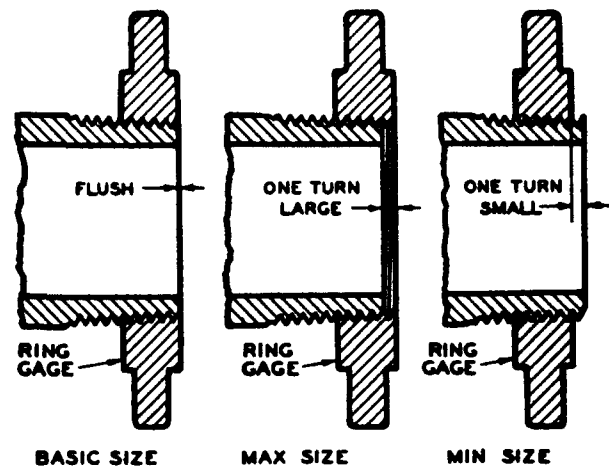


FIGURE VII.7.—Gaging external taper threads with thin ring gage.

should be flush with the bottom of the chamfer, which shall be considered as being the intersection of the chamfer cone and the pitch cone of the thread (see view B, fig. VII.9). In general, this depth is equal to one-half thread or approximately  $p/2$  from the face of the valve or fitting.

TABLE VII.9.—Basic dimensions of threaded plug and ring gages for American Standard taper pipe threads, NPT

| Nominal size of pipe | Threads per inch, $n$ | Pitch, $p$ | Major diameters of plug gages <sup>a, b</sup>               |                                                                |                                                                        | Pitch diameters of plug and ring gages |                        |                                | Minor diameters of ring gages <sup>a</sup>            |                                                          |                                                                  | Increase in diameter per thread, $\left(\frac{0.066025}{n}\right)$ | Thickness of thin ring, $L_1$ | Thickness of full ring, $L_2$ |
|----------------------|-----------------------|------------|-------------------------------------------------------------|----------------------------------------------------------------|------------------------------------------------------------------------|----------------------------------------|------------------------|--------------------------------|-------------------------------------------------------|----------------------------------------------------------|------------------------------------------------------------------|--------------------------------------------------------------------|-------------------------------|-------------------------------|
|                      |                       |            | At small end, $E_0 + \left(\frac{0.066025}{n}\right) = D_0$ | At gaging notch, $E_1 + \left(\frac{0.066025}{n}\right) = D_1$ | At large end, full ring, $E_2 + \left(\frac{0.066025}{n}\right) = D_2$ | At small end, $E_0$                    | At gaging notch, $E_1$ | At large end, full ring, $E_2$ | At small end, $E_0 - \left(\frac{0.066025}{n}\right)$ | At gaging notch, $E_1 - \left(\frac{0.066025}{n}\right)$ | At large end, full ring, $E_2 - \left(\frac{0.066025}{n}\right)$ |                                                                    |                               |                               |
| 1                    | 2                     | 3          | 4                                                           | 5                                                              | 6                                                                      | 7                                      | 8                      | 9                              | 10                                                    | 11                                                       | 12                                                               | 13                                                                 | 14                            | 15                            |
| <i>in.</i>           |                       | <i>in.</i> | <i>in.</i>                                                  | <i>in.</i>                                                     | <i>in.</i>                                                             | <i>in.</i>                             | <i>in.</i>             | <i>in.</i>                     | <i>in.</i>                                            | <i>in.</i>                                               | <i>in.</i>                                                       | <i>in.</i>                                                         | <i>in.</i>                    | <i>in.</i>                    |
| $\frac{1}{16}$ ..... | 27                    | 0.03704    | 0.29585                                                     | 0.30585                                                        | 0.31217                                                                | 0.27118                                | 0.28118                | 0.28750                        | 0.24551                                               | 0.25651                                                  | 0.26283                                                          | 0.00231                                                            | 0.160                         | 0.26111                       |
| $\frac{1}{8}$ .....  | 27                    | 0.03704    | 0.38818                                                     | 0.39827                                                        | 0.40467                                                                | 0.35351                                | 0.37360                | 0.39000                        | 0.33984                                               | 0.34993                                                  | 0.35533                                                          | 0.00231                                                            | 0.1615                        | 0.26385                       |
| $\frac{1}{4}$ .....  | 18                    | 0.05556    | 0.51439                                                     | 0.52863                                                        | 0.53950                                                                | 0.47739                                | 0.49163                | 0.50250                        | 0.44039                                               | 0.45463                                                  | 0.45550                                                          | 0.00347                                                            | 0.2278                        | 0.40178                       |
| $\frac{3}{8}$ .....  | 18                    | 0.05556    | 0.64902                                                     | 0.66402                                                        | 0.67450                                                                | 0.61201                                | 0.62701                | 0.63750                        | 0.57501                                               | 0.59001                                                  | 0.60050                                                          | 0.00347                                                            | 0.240                         | 0.40778                       |
| $\frac{1}{2}$ .....  | 14                    | 0.07143    | 0.80600                                                     | 0.82600                                                        | 0.83936                                                                | 0.75843                                | 0.77843                | 0.79179                        | 0.71086                                               | 0.73086                                                  | 0.74422                                                          | 0.00446                                                            | 0.330                         | 0.53371                       |
| $\frac{3}{4}$ .....  | 14                    | 0.07143    | 1.01525                                                     | 1.03644                                                        | 1.04936                                                                | 0.96768                                | 0.98887                | 1.00179                        | 0.92011                                               | 0.94129                                                  | 0.95422                                                          | 0.00446                                                            | 0.329                         | 0.54571                       |
| 1.....               | 11½                   | 0.08696    | 1.27154                                                     | 1.29654                                                        | 1.31422                                                                | 1.21363                                | 1.23463                | 1.25630                        | 1.15572                                               | 1.18072                                                  | 1.19839                                                          | 0.00543                                                            | 0.400                         | 0.68278                       |
| 1½.....              | 11½                   | 0.08696    | 1.61504                                                     | 1.64129                                                        | 1.65922                                                                | 1.55713                                | 1.58335                | 1.60130                        | 1.49922                                               | 1.52547                                                  | 1.54339                                                          | 0.00543                                                            | 0.420                         | 0.70678                       |
| 2.....               | 11½                   | 0.08696    | 1.85400                                                     | 1.88025                                                        | 1.89922                                                                | 1.79609                                | 1.82234                | 1.84130                        | 1.73817                                               | 1.76442                                                  | 1.78339                                                          | 0.00543                                                            | 0.420                         | 0.72349                       |
| 2½.....              | 11½                   | 0.08696    | 2.32393                                                     | 2.35418                                                        | 2.37422                                                                | 2.26902                                | 2.29627                | 2.31630                        | 2.21111                                               | 2.23836                                                  | 2.25839                                                          | 0.00543                                                            | 0.436                         | 0.75652                       |
| 3.....               | 8                     | 0.12500    | 2.80278                                                     | 2.84541                                                        | 2.87388                                                                | 2.71953                                | 2.76216                | 2.79062                        | 2.63628                                               | 2.67891                                                  | 2.70737                                                          | 0.00781                                                            | 0.682                         | 1.13750                       |
| 3½.....              | 8                     | 0.12500    | 3.42338                                                     | 3.47175                                                        | 3.49888                                                                | 3.34062                                | 3.38550                | 3.41562                        | 3.25737                                               | 3.30525                                                  | 3.33237                                                          | 0.00781                                                            | 0.766                         | 1.20000                       |
| 4.....               | 8                     | 0.12500    | 3.92075                                                     | 3.97207                                                        | 3.99888                                                                | 3.83750                                | 3.88851                | 3.91562                        | 3.75425                                               | 3.80556                                                  | 3.83237                                                          | 0.00781                                                            | 0.821                         | 1.25000                       |
| 5.....               | 8                     | 0.12500    | 4.41763                                                     | 4.47039                                                        | 4.49888                                                                | 4.33435                                | 4.37372                | 4.41562                        | 4.25112                                               | 4.30347                                                  | 4.33237                                                          | 0.00781                                                            | 0.844                         | 1.30000                       |
| 6.....               | 8                     | 0.12500    | 5.47398                                                     | 5.53255                                                        | 5.56198                                                                | 5.39073                                | 5.44929                | 5.47862                        | 5.30748                                               | 5.36604                                                  | 5.39537                                                          | 0.00781                                                            | 0.937                         | 1.40630                       |
| 8.....               | 8                     | 0.12500    | 6.52935                                                     | 6.58922                                                        | 6.62398                                                                | 6.44909                                | 6.50597                | 6.54062                        | 6.37284                                               | 6.42272                                                  | 6.45737                                                          | 0.00781                                                            | 0.958                         | 1.51250                       |
| 10.....              | 8                     | 0.12500    | 8.51695                                                     | 8.58328                                                        | 8.62398                                                                | 8.43359                                | 8.50003                | 8.54062                        | 8.35034                                               | 8.41678                                                  | 8.45737                                                          | 0.00781                                                            | 1.063                         | 1.71250                       |
| 12.....              | 8                     | 0.12500    | 10.62357                                                    | 10.70419                                                       | 10.74988                                                               | 10.54531                               | 10.62094               | 10.66562                       | 10.46206                                              | 10.53768                                                 | 10.58237                                                         | 0.00781                                                            | 1.210                         | 1.92500                       |
| 14 OD.....           | 8                     | 0.12500    | 12.61607                                                    | 12.70107                                                       | 12.74988                                                               | 12.53291                               | 12.61781               | 12.66562                       | 12.44956                                              | 12.53456                                                 | 12.58237                                                         | 0.00781                                                            | 1.350                         | 2.12500                       |
| 16 OD.....           | 8                     | 0.12500    | 13.85825                                                    | 13.95588                                                       | 13.99888                                                               | 13.77500                               | 13.87262               | 13.91562                       | 13.69175                                              | 13.78937                                                 | 13.83237                                                         | 0.00781                                                            | 1.562                         | 2.25000                       |
| 18 OD.....           | 8                     | 0.12500    | 15.84575                                                    | 15.95900                                                       | 15.99888                                                               | 15.76250                               | 15.87575               | 15.91562                       | 15.67925                                              | 15.79250                                                 | 15.83237                                                         | 0.00781                                                            | 1.812                         | 2.45000                       |
| 20 OD.....           | 8                     | 0.12500    | 17.83325                                                    | 17.95825                                                       | 17.99888                                                               | 17.75000                               | 17.87500               | 17.91562                       | 17.66675                                              | 17.79175                                                 | 17.83237                                                         | 0.00781                                                            | 2.000                         | 2.65000                       |
| 24 OD.....           | 8                     | 0.12500    | 19.82075                                                    | 19.95357                                                       | 19.99888                                                               | 19.73750                               | 19.87031               | 19.91562                       | 19.65425                                              | 19.78706                                                 | 19.83237                                                         | 0.00781                                                            | 2.125                         | 2.85000                       |
| 24 OD.....           | 8                     | 0.12500    | 23.79575                                                    | 23.94419                                                       | 23.99888                                                               | 23.71250                               | 23.86094               | 23.91562                       | 23.62925                                              | 23.77768                                                 | 23.83237                                                         | 0.00781                                                            | 2.375                         | 3.25000                       |

<sup>a</sup> These dimensions are based on a crest truncation of 0.1p for pipe thread gages, which insures bearing of the gage on the sides of the thread, when the product thread is cut with a slightly dull tool, instead of at the roots of the thread.

<sup>b</sup> Second plug gage to be larger to provide for major diameters of  $E_0 + \frac{0.8}{n}$  at small end,  $E_1 + \frac{0.8}{n}$  at gaging notch, and  $E_2 + \frac{0.8}{n}$  at large end, full ring.

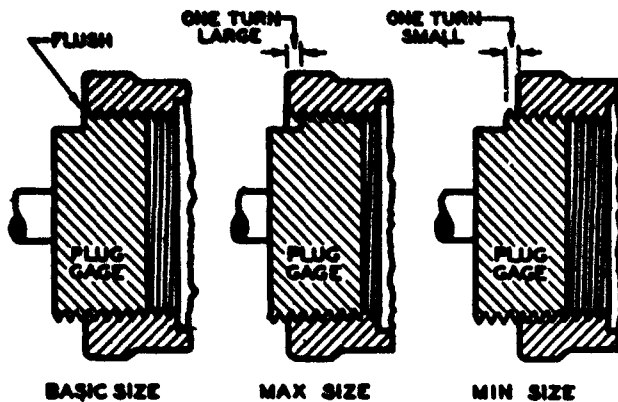


FIGURE VII.8.—Gaging internal taper threads.

7. DIRECT MEASUREMENT.—Taper pipe threads on the product are regularly checked only by gaging, but where a more exact check may be needed on threaded pipe made of steel, wrought iron, or brass, and on other threaded products of steel, direct measurement of threads may be specified.

8. GAGING OF STRAIGHT PIPE THREADS.—(a) *Types of gages.*—Gages to properly control the production of these straight threads should be either straight “go” and “not go” gages or the regular American Standard taper pipe thread gages as indicated below.

(b) *Use of straight and taper gages.*—Straight “go” and “not go” gages should be used for all types of threaded joints where both the external and internal threads are straight. Taper plug gages may be used for the internal threads of all types of mechanical joints where the external thread is tapered and the internal thread is straight.

TABLE VII.10.—Tolerances for American Standard reference and inspection (working) taper pipe thread plug and ring gages, NPT

| Nominal pipe size | Threads per inch | Tolerance on pitch diameter <sup>a</sup> | Tolerance on lead <sup>b, d</sup> |        | Tolerance on half angle <sup>c</sup> |           | Tolerance on taper <sup>e, f</sup> |          | Tolerance on major diameter <sup>f</sup> | Tolerance on minor diameter <sup>g</sup> | Total cumulative tolerances on pitch diameter |         | Standoff between plug and ring gages at gaging notch for dimensions at opposite extreme tolerance limits <sup>h</sup> |
|-------------------|------------------|------------------------------------------|-----------------------------------|--------|--------------------------------------|-----------|------------------------------------|----------|------------------------------------------|------------------------------------------|-----------------------------------------------|---------|-----------------------------------------------------------------------------------------------------------------------|
|                   |                  |                                          | Plugs                             | Rings  | Plugs                                | Rings     | Plugs                              | Rings    |                                          |                                          | Plugs                                         | Rings   |                                                                                                                       |
| 1                 | 2                | 3                                        | 4                                 | 5      | 6                                    | 7         | 8                                  | 9        | 10                                       | 11                                       | 12                                            | 13      | 14                                                                                                                    |
| in.               |                  | in.<br>±                                 | in.                               | in.    | min.<br>±                            | min.<br>± | in.<br>+                           | in.<br>- | in.                                      | in.<br>+                                 | in.                                           | in.     | in.                                                                                                                   |
| 1/16              | 27               | 0.0002                                   | 0.0002                            | 0.0003 | 15                                   | 20        | 0.0003                             | 0.0006   | 0.0004                                   | 0.0004                                   | 0.00080                                       | 0.00118 | 0.032                                                                                                                 |
| 3/16              | 27               | .0002                                    | .0002                             | .0003  | 15                                   | 20        | .0003                              | .0006    | .0004                                    | .0004                                    | .00080                                        | .00118  | .032                                                                                                                  |
| 1/4               | 18               | .0002                                    | .0002                             | .0003  | 15                                   | 20        | .0004                              | .0007    | .0006                                    | .0006                                    | .00092                                        | .00134  | .035                                                                                                                  |
| 3/8               | 18               | .0002                                    | .0002                             | .0003  | 15                                   | 20        | .0004                              | .0007    | .0006                                    | .0006                                    | .00092                                        | .00134  | .035                                                                                                                  |
| 1/2               | 14               | .0003                                    | .0002                             | .0003  | 10                                   | 15        | .0006                              | .0009    | .0010                                    | .0010                                    | .00097                                        | .00142  | .033                                                                                                                  |
| 3/4               | 14               | .0003                                    | .0002                             | .0003  | 10                                   | 15        | .0006                              | .0009    | .0010                                    | .0010                                    | .00097                                        | .00142  | .033                                                                                                                  |
| 1                 | 11 1/2           | .0003                                    | .0003                             | .0004  | 10                                   | 15        | .0008                              | .0012    | .0010                                    | .0010                                    | .00121                                        | .00170  | .047                                                                                                                  |
| 1 1/4             | 11 1/2           | .0003                                    | .0003                             | .0004  | 10                                   | 15        | .0008                              | .0012    | .0010                                    | .0010                                    | .00121                                        | .00170  | .047                                                                                                                  |
| 1 1/2             | 11 1/2           | .0003                                    | .0003                             | .0004  | 10                                   | 15        | .0008                              | .0012    | .0010                                    | .0010                                    | .00121                                        | .00170  | .047                                                                                                                  |
| 2                 | 11 1/2           | .0003                                    | .0003                             | .0004  | 10                                   | 15        | .0008                              | .0012    | .0010                                    | .0010                                    | .00121                                        | .00170  | .047                                                                                                                  |
| 2 1/4             | 8                | .0005                                    | .0004                             | .0005  | 7                                    | 10        | .0010                              | .0014    | .0016                                    | .0016                                    | .00158                                        | .00211  | .059                                                                                                                  |
| 3                 | 8                | .0005                                    | .0004                             | .0005  | 7                                    | 10        | .0010                              | .0014    | .0016                                    | .0016                                    | .00158                                        | .00211  | .059                                                                                                                  |
| 3 1/4             | 8                | .0005                                    | .0004                             | .0005  | 7                                    | 10        | .0010                              | .0014    | .0016                                    | .0016                                    | .00158                                        | .00211  | .059                                                                                                                  |
| 4                 | 8                | .0005                                    | .0004                             | .0005  | 7                                    | 10        | .0010                              | .0014    | .0016                                    | .0016                                    | .00158                                        | .00211  | .059                                                                                                                  |
| 5                 | 8                | .0005                                    | .0004                             | .0005  | 7                                    | 10        | .0010                              | .0014    | .0016                                    | .0016                                    | .00158                                        | .00211  | .059                                                                                                                  |
| 6                 | 8                | .0005                                    | .0004                             | .0005  | 7                                    | 10        | .0010                              | .0014    | .0016                                    | .0016                                    | .00158                                        | .00211  | .059                                                                                                                  |
| 8                 | 8                | .0005                                    | .0004                             | .0005  | 7                                    | 10        | .0010                              | .0014    | .0020                                    | .0020                                    | .00158                                        | .00211  | .059                                                                                                                  |
| 10                | 8                | .0005                                    | .0004                             | .0005  | 7                                    | 10        | .0010                              | .0014    | .0020                                    | .0020                                    | .00158                                        | .00211  | .059                                                                                                                  |
| 12                | 8                | .0005                                    | .0004                             | .0005  | 7                                    | 10        | .0010                              | .0014    | .0020                                    | .0020                                    | .00158                                        | .00211  | .059                                                                                                                  |
| 14 OD             | 8                | .0008                                    | .0005                             | .0006  | 7                                    | 10        | .0010                              | .0014    | .0030                                    | .0030                                    | .00206                                        | .00271  | .076                                                                                                                  |
| 16 OD             | 8                | .0008                                    | .0005                             | .0006  | 7                                    | 10        | .0010                              | .0014    | .0030                                    | .0030                                    | .00206                                        | .00271  | .076                                                                                                                  |
| 18 OD             | 8                | .0008                                    | .0005                             | .0006  | 7                                    | 10        | .0010                              | .0014    | .0030                                    | .0030                                    | .00206                                        | .00271  | .076                                                                                                                  |
| 20 OD             | 8                | .0008                                    | .0005                             | .0006  | 7                                    | 10        | .0010                              | .0014    | .0030                                    | .0030                                    | .00206                                        | .00271  | .076                                                                                                                  |
| 24 OD             | 8                | .0008                                    | .0005                             | .0006  | 7                                    | 10        | .0010                              | .0014    | .0030                                    | .0030                                    | .00206                                        | .00271  | .076                                                                                                                  |

<sup>a</sup> To be measured at the gaging notch of plug gage.

<sup>b</sup> Allowable variation in lead between any two threads in  $L_1$  length of gage (figs. VII.4 and VII.6).

<sup>c</sup> In solving for the correction in diameter for angle deviations, the average deviation in half angle for the two sides of thread regardless of their signs should be taken.

<sup>d</sup> The lead and taper on plug and ring gages shall be measured along the pitch line, omitting the imperfect threads at each end.

<sup>e</sup> Allowable variation in taper, in  $L_1$  length of gage (figs. VII.4 and VII.6).

<sup>f</sup> Tolerance on major diameter of plug gage at gaging notch.

<sup>g</sup> Tolerance on minor diameter of ring gage at large end.

<sup>h</sup> Maximum possible interchange standoff, any ring against any plug other than its master plug, may occur when taper deviations are zero and all other dimensions are at opposite extreme tolerance limits. Average standoff should be well within these maximum limits.

NOTE.—The large end of the ring gage shall be flush with the gaging notch of its master plug gage when assembled handtight within  $\pm 0.002$  in. for sizes 1/16 to 2 in., inclusive, within  $\pm 0.003$  in. for sizes 2 1/4 to 12 in., inclusive, and within  $\pm 0.005$  in. for sizes 14 in. and larger.

The tolerances for the length  $L_1$  from small end to gaging notch of the plug gage (figs. VII.4 and VII.6) shall be  $+0.000$  and  $-0.001$  for sizes 1/16 to 2 in., inclusive, and  $+0.000$  and  $-0.002$  for sizes 2 1/4 in. and larger.

The tolerances for the over-all thread length  $L_2$  of the plug gage (figs. VII.4 and VII.6) shall be  $+0.005$  and  $-0.000$  for sizes 1/16 to 2 in., inclusive, and  $+0.010$  and  $-0.000$  for sizes 2 1/4 in. and larger.

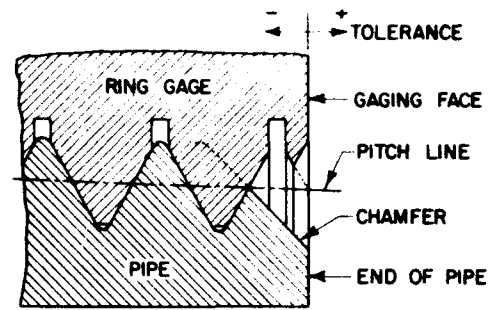
Tolerances for the thickness  $L_3$  of the ring gage (figs. VII.4 and VII.6) shall be  $+0.001$  and  $-0.000$  for sizes 1/16 to 2 in., inclusive, and  $+0.002$  and  $-0.000$  for sizes 2 1/4 in. and larger.

TABLE VII.11.—Diameter equivalent of deviation in half included angle for tools and gages \*

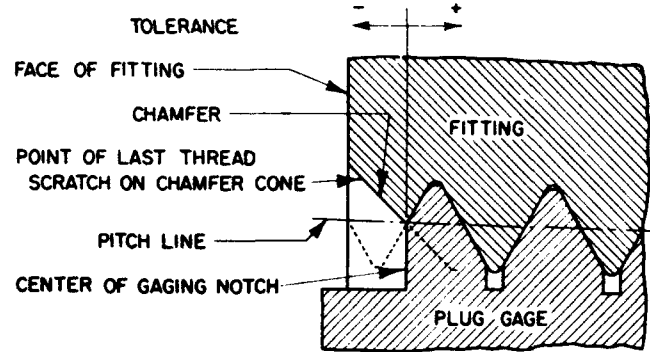
| Deviation, $\delta\alpha$ | 8 threads per inch | 11½ threads per inch | 14 threads per inch | 18 threads per inch | 27 threads per inch |
|---------------------------|--------------------|----------------------|---------------------|---------------------|---------------------|
| 1                         | 2                  | 3                    | 4                   | 5                   | 6                   |
| <i>min.</i>               | <i>in.</i>         | <i>in.</i>           | <i>in.</i>          | <i>in.</i>          | <i>in.</i>          |
| 1.....                    | 0.00006            | 0.00004              | 0.00003             | 0.00002             | 0.00002             |
| 2.....                    | .00011             | .00008               | .00006              | .00005              | .00003              |
| 3.....                    | .00017             | .00012               | .00010              | .00007              | .00005              |
| 4.....                    | .00022             | .00016               | .00013              | .00010              | .00007              |
| 5.....                    | .00028             | .00019               | .00016              | .00012              | .00008              |
| 6.....                    | .00034             | .00023               | .00019              | .00015              | .00010              |
| 7.....                    | .00039             | .00027               | .00022              | .00017              | .00012              |
| 8.....                    | .00045             | .00031               | .00026              | .00020              | .00013              |
| 9.....                    | .00050             | .00035               | .00029              | .00022              | .00015              |
| 10.....                   | .00056             | .00039               | .00032              | .00025              | .00017              |
| 11.....                   | .00062             | .00043               | .00035              | .00027              | .00018              |
| 12.....                   | .00067             | .00047               | .00038              | .00030              | .00020              |
| 13.....                   | .00073             | .00051               | .00042              | .00032              | .00022              |
| 14.....                   | .00078             | .00054               | .00045              | .00035              | .00023              |
| 15.....                   | .00084             | .00058               | .00048              | .00037              | .00025              |
| 16.....                   | .00089             | .00062               | .00051              | .00040              | .00027              |
| 17.....                   | .00095             | .00066               | .00054              | .00042              | .00028              |
| 18.....                   | .00101             | .00070               | .00058              | .00045              | .00030              |
| 19.....                   | .00106             | .00074               | .00061              | .00047              | .00031              |
| 20.....                   | .00112             | .00078               | .00064              | .00050              | .00033              |
| 21.....                   | .00117             | .00082               | .00067              | .00052              | .00035              |
| 22.....                   | .00123             | .00086               | .00070              | .00055              | .00036              |
| 23.....                   | .00129             | .00089               | .00074              | .00057              | .00038              |
| 24.....                   | .00134             | .00093               | .00077              | .00060              | .00040              |
| 25.....                   | .00140             | .00097               | .00080              | .00062              | .00041              |
| 26.....                   | .00145             | .00101               | .00083              | .00065              | .00043              |
| 27.....                   | .00151             | .00105               | .00086              | .00067              | .00045              |
| 28.....                   | .00157             | .00109               | .00089              | .00070              | .00046              |
| 29.....                   | .00162             | .00113               | .00093              | .00072              | .00048              |
| 30.....                   | .00168             | .00117               | .00096              | .00075              | .00050              |
| 40.....                   | .00252             | .00175               | .00144              | .00112              | .00075              |
| 60.....                   | .00336             | .00233               | .00192              | .00149              | .00099              |

\* In solving for the diameter equivalent of angle deviations the average deviation in half angle for the two sides of the thread regardless of their signs should be taken.

\* Diameter equivalent =  $1.53812p \tan \delta\alpha$ , where  $\delta\alpha$  = deviation in half angle of thread.



(A) ENLARGED VIEW SHOWING CHAMFERED EXTERNAL THREAD OF BASIC SIZE



NOTE: CENTER OF GAGING NOTCH SHOULD INTERSECT FLANK OF THREAD AT OR NEAR PITCH LINE.

(B) ENLARGED VIEW SHOWING CHAMFERED INTERNAL THREAD OF BASIC SIZE

FIGURE VII.9.—Gaging of chamfered threads (see par. 6, p. 14).

NOTE.—The chamfer illustrated is at 45° angle and is ½ pitch in depth. However, these details are not requirements and are given only for information on the illustration shown. The chamfered portion of thread, and the full chamfer cone, are indicated by dotted lines.

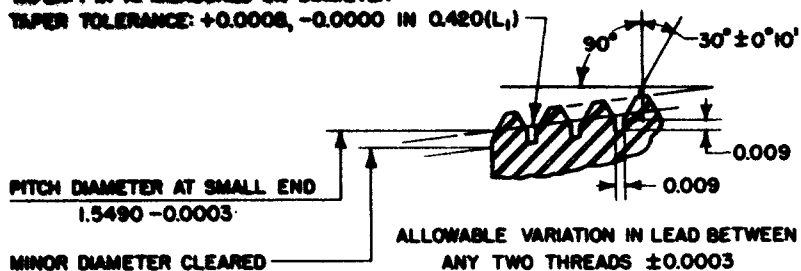
TABLE VII.12.—Diameter equivalent of deviation in pitch for tools and gages \*

| Deviation, $\delta p$ | 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         |
| <i>in.</i>            | <i>in.</i> | <i>in.</i> | <i>in.</i> | <i>in.</i> | <i>in.</i> | <i>in.</i> | <i>in.</i> | <i>in.</i> | <i>in.</i> | <i>in.</i> |
| 0.00000.....          | 0.00000    | 0.00002    | 0.00003    | 0.00005    | 0.00007    | 0.00009    | 0.00010    | 0.00012    | 0.00014    | 0.00016    |
| 0.00010.....          | .00017     | .00019     | .00021     | .00023     | .00024     | .00026     | .00028     | .00029     | .00031     | .00033     |
| 0.00020.....          | .00035     | .00036     | .00038     | .00040     | .00042     | .00043     | .00045     | .00047     | .00048     | .00050     |
| 0.00030.....          | .00052     | .00054     | .00055     | .00057     | .00059     | .00061     | .00062     | .00064     | .00066     | .00068     |
| 0.00040.....          | .00069     | .00071     | .00073     | .00074     | .00076     | .00078     | .00080     | .00081     | .00083     | .00085     |
| 0.00050.....          | .00087     | .00088     | .00090     | .00092     | .00094     | .00095     | .00097     | .00099     | .01000     | .00102     |
| 0.00060.....          | .00104     | .00106     | .00107     | .00109     | .00111     | .00113     | .00114     | .00116     | .00118     | .00120     |
| 0.00070.....          | .00121     | .00123     | .00125     | .00126     | .00128     | .00130     | .00132     | .00133     | .00135     | .00137     |
| 0.00080.....          | .00139     | .00140     | .00142     | .00144     | .00145     | .00147     | .00149     | .00151     | .00152     | .00154     |
| 0.00090.....          | .00156     | .00158     | .00159     | .00161     | .00163     | .00165     | .00166     | .00168     | .00170     | .00171     |
| 0.00100.....          | .00173     | .00175     | .00177     | .00178     | .00180     | .00182     | .00184     | .00185     | .00187     | .00189     |
| 0.00110.....          | .00191     | .00192     | .00194     | .00196     | .00197     | .00199     | .00201     | .00203     | .00204     | .00206     |
| 0.00120.....          | .00208     | .00210     | .00211     | .00213     | .00215     | .00217     | .00218     | .00220     | .00222     | .00223     |
| 0.00130.....          | .00225     | .00227     | .00229     | .00230     | .00232     | .00234     | .00236     | .00237     | .00239     | .00241     |
| 0.00140.....          | .00242     | .00244     | .00246     | .00248     | .00249     | .00251     | .00253     | .00255     | .00256     | .00258     |
| 0.00150.....          | .00250     | .00252     | .00253     | .00255     | .00257     | .00258     | .00260     | .00272     | .00274     | .00275     |
| 0.00160.....          | .00277     | .00279     | .00281     | .00282     | .00284     | .00286     | .00288     | .00289     | .00291     | .00293     |
| 0.00170.....          | .00294     | .00296     | .00298     | .00300     | .00301     | .00303     | .00305     | .00307     | .00308     | .00310     |
| 0.00180.....          | .00312     | .00313     | .00315     | .00317     | .00319     | .00320     | .00322     | .00324     | .00326     | .00327     |
| 0.00190.....          | .00329     | .00331     | .00333     | .00334     | .00336     | .00338     | .00339     | .00341     | .00343     | .00345     |
| 0.00200.....          | .00346     | .00348     | .00350     | .00352     | .00353     | .00355     | .00357     | .00359     | .00360     | .00362     |

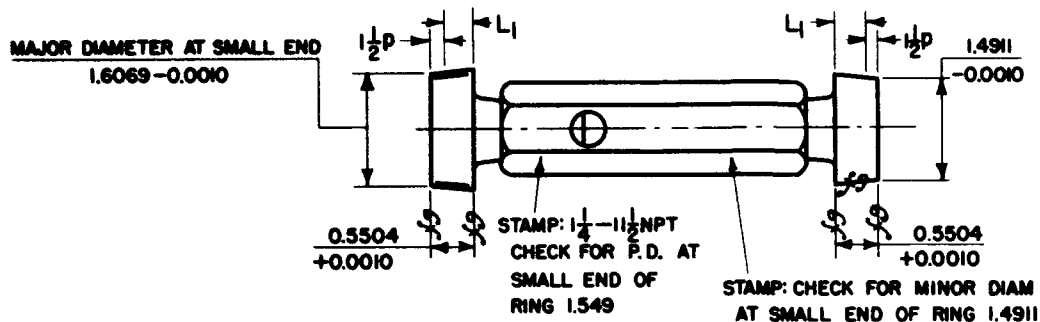
\* Diameter equivalent =  $1.732\delta p$ , where  $\delta p$  = deviation in pitch between any two threads.

TAPER: 1 IN 16 MEASURED ON DIAMETER

TAPER TOLERANCE:  $+0.0008, -0.0000$  IN  $0.420(L_1)$



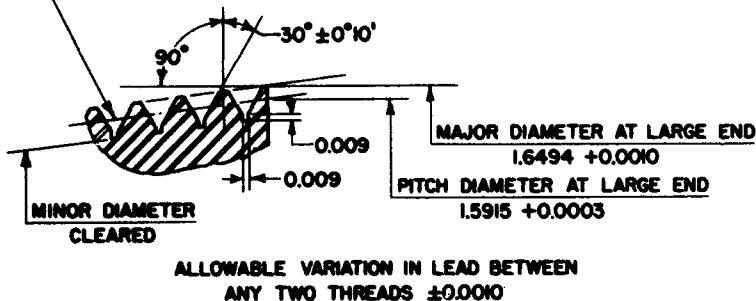
### CHECK PLUG THREADS ENLARGED CROSS SECTION



### TAPER CHECK PLUG GAGES

TAPER: 1 IN 16 MEASURED ON DIAMETER

TAPER TOLERANCE:  $+0.0008, -0.0000$  IN  $0.420(L_1)$

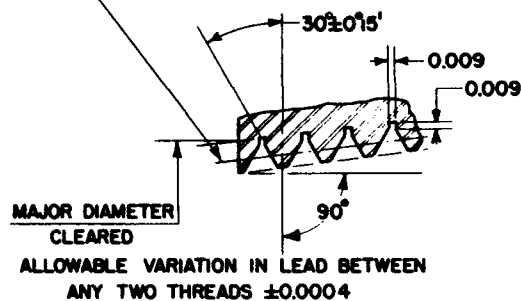


ALLOWABLE VARIATION IN LEAD BETWEEN  
ANY TWO THREADS  $\pm 0.0010$

### PLUG THREADS ENLARGED CROSS SECTION

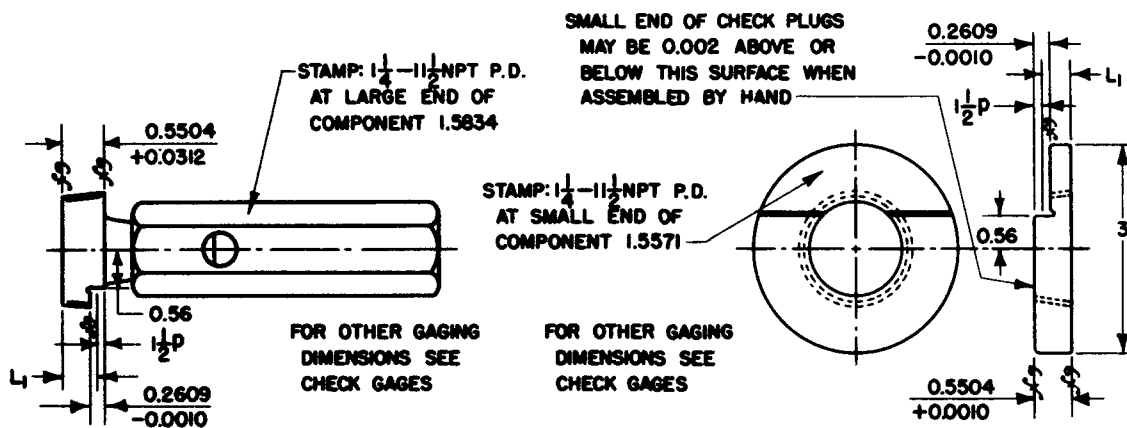
TAPER: 1 IN 16 MEASURED ON DIAMETER

TAPER TOLERANCE:  $-0.0012, +0.0000$  IN  $0.420(L_1)$



ALLOWABLE VARIATION IN LEAD BETWEEN  
ANY TWO THREADS  $\pm 0.0004$

### RING THREADS ENLARGED CROSS SECTION



### TAPER THREAD PLUG GAGE

### TAPER THREAD RING GAGE

DIMENSIONS IN INCHES UNLESS OTHERWISE SPECIFIED

FIGURE VII.10.—Method of marking and dimensioning taper pipe thread gages.

(c) *Gaging pressure-tight joints.*—Taper thread gages shall be used to gage straight internal pipe threads forming part of pressure-tight joints where the external thread is tapered.

The gaging notch on the American Standard taper pipe thread plug gage shall come flush with the end of the American Standard coupling straight pipe thread, NPSC, table VII.4, p. 7, or with the bottom of chamfer, if chamfered, allowing a tolerance of one and one-half turns large or small to gage.

(d) *Gage dimensions.*—The straight "go" and "not go" plug and ring gages used for checking mechanical joint threads, tables VII.6 and VII.7, p. 9 and 10, shall be made to the pitch diameter limits specified in the product tables in accordance with standard practice for straight thread gages.

The minimum major diameter of the "go" thread plug gage shall be equal to the minimum pitch diameter of the internal thread plus an amount equal to  $0.649519p$ . The maximum major diameter of the "not go" thread plug gage shall be equal to the maximum pitch diameter of the internal thread plus an amount equal to  $\frac{1}{2}$  of  $0.649519p$  ( $=0.433013p$ ).

The maximum minor diameter of the "go" thread ring gage shall be equal to the maximum pitch diameter of the external thread minus an amount equal to  $0.649519p$ . The minimum minor diameter of the "not go" thread ring gage shall be equal to the minimum pitch diameter of the external thread minus an amount equal to  $\frac{1}{2}$  of  $0.649519p$  ( $=0.433013p$ ).

(e) *Gage tolerances.*—The tolerances on all gages should be in accordance with the gage tolerances specified for American Standard taper pipe thread, NPT, gages in table VII.10, p. 15.

9. MARKING AND DIMENSIONING OF GAGES.—Each gage shall be marked so as clearly to indicate the nominal size of pipe, threads per inch, and the proper thread series designation as given in the respective section of this standard. Taper pipe thread gages shall be marked and dimensioned in accordance with figure VII.10.

## SECTION VIII. DRYSEAL AMERICAN STANDARD PIPE THREADS <sup>5</sup>

### 1. INTRODUCTION

The significant feature of these threads is control of truncation at the crest and root to assure metal to metal contact coincident with or prior to flank contact<sup>4</sup>. Contact at the crest and root prevents spiral leakage and insures pressure-tight joints without the use of a lubricant or sealer. See figure VIII.1. If not functionally objectionable, lubricants may be used to minimize the possibility of galling in assembly.

<sup>4</sup> This section is substantially in agreement with the present issue of ASA B2.2, "American Standard Dryseal Pipe Threads," which is published by the ASME, 29 West 39th Street, New York 18, N.Y. The latest revision should be consulted when referring to this ASA standard.

The principal uses for this thread during its development were for refrigerant, marine, automotive, and aircraft fuel and oil line fittings, drain and filler plugs, ordnance gas shells, chemical bombs, etc.

External Dryseal pipe threads are tapered only. Internal Dryseal pipe threads may be either straight or tapered, as specified. All Dryseal pipe threads are right-hand.

1. THREAD TYPES.—Dryseal pipe threads are of four types, as follows:

Type 1—Dryseal American Standard Taper Pipe Thread, NPTF

Type 2—Dryseal SAE Short Taper Pipe Thread, PTF-SAE SHORT

Type 3—Dryseal American Standard Fuel Internal Straight Pipe Thread, NPSF

Type 4—Dryseal American Standard Intermediate Internal Straight Pipe Thread, NPSI

2. THREAD DESIGNATIONS.—The above types of Dryseal pipe threads are designated by specifying in sequence the nominal size, number of threads per inch, form (Dryseal), and symbol of the thread series, as follows:

1/8—27 DRYSEAL NPTF

1/8—27 DRYSEAL PTF-SAE SHORT

1/8—27 DRYSEAL NPSF

1/8—27 DRYSEAL NPSI

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

N=American (National)<sup>2a</sup> Standard

P=Pipe

T=Taper

S=Straight

F=Fuel and Oil

I=Intermediate

3. APPENDIX.—Appendix 7 contains the following additional information on the pipe threads covered by this section:

Definitions and letter symbols.

Suggested twist drill diameters for drilled hole sizes for Dryseal pipe threads.

Pitch diameters of taper pipe threads shown in their relation to  $E_1$ , basic pitch diameter.

Special short, PTF-SPL SHORT; special extra short, PTF-SPL EXTRA SHORT; fine thread, F-PTF; and special diameter-pitch combination, SPL-PTF, Dryseal pipe threads.

Dryseal dimensions derived from superseded dimensions of  $L_1$  equals 0.1800 for the  $\frac{1}{8}$ —27 size and 0.2000 for the  $\frac{1}{4}$ —18 size.

### 2. THREAD FORM

The angle between the flanks of the thread is  $60^\circ$  when measured on an axial plane and the line bisecting this angle is perpendicular to the axis

<sup>2a</sup> See p. 1.

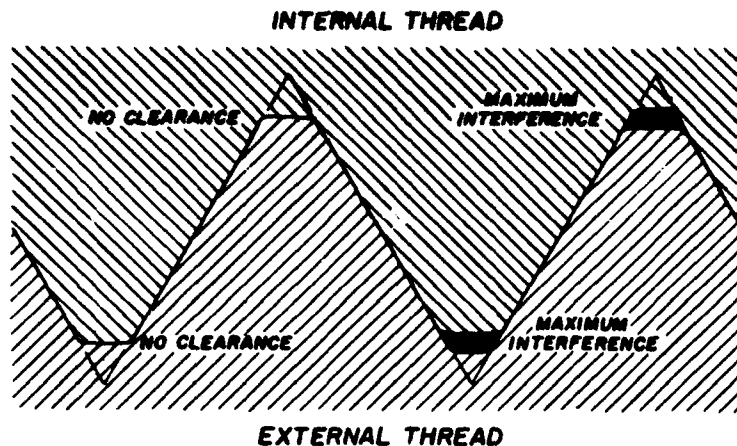


FIGURE VIII.1.—Dryseal American Standard pipe threads for pressure-tight joints.

NOTE.—When threaded joints are made up wrench tight without lubricant or sealer, it is intended that the flanks and the crests and roots shall be in contact

of both the taper and straight threads. Tolerances on thread elements are described in par. 2, below and given in table VIII.1.

The sketches at the head of table VIII.2 give a sectional view of this modified thread form. When the crests and roots of commercially manufactured product are examined closely, they will be found to be slightly rounded at the edges. It is intended that the pipe threads of this form on products shall be acceptable when the entire crests and roots lie within the ~~minimum~~ limits of table VIII.2.<sup>a</sup>

1. MANUFACTURING TOLERANCE ON PRODUCT.—\*The maximum allowable variation in the Dryseal Standard (NPTF) commercial product is 1 turn large or 1 turn small from the gaging notch on the plug and the gaging face of the ring

when gages are screwed up firmly by hand on or in the product. For other types of Dryseal threads smaller tolerances are specified as indicated in tables VIII.14, VIII.20, and VIII.21. Proper allowance shall be made for any variation of the gage from basic dimensions.

2. TOLERANCES ON THREAD ELEMENTS.—The permissible variations in thread elements on steel products and all pipe made of steel, wrought iron, or brass, exclusive of butt-weld pipe, are given in table VIII.1. This table is a guide for establishing limits of the thread elements of taps, dies, and thread chasers. These limits may be required on product threads. Limits and tolerances for crest and root truncations are given in table VIII.2.

<sup>a</sup> The crests and roots of the external and internal threads may be truncated either parallel to the pitch line or parallel to the axis.

TABLE VIII.1.—Tolerances on taper, lead, and angle for Dryseal American Standard threads on pipe and fittings

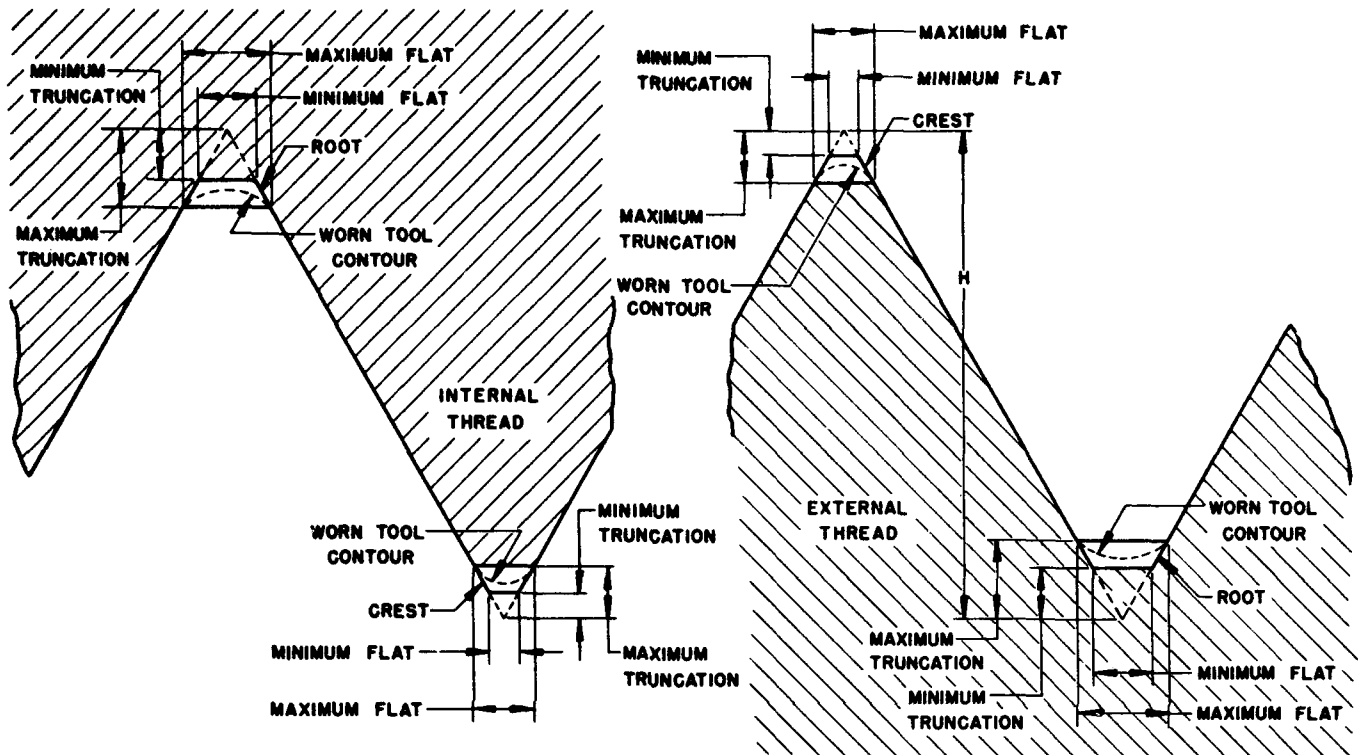
| Nominal pipe size | Threads per inch | Taper on pitch line |        | Lead in length of effective thread <sup>a,b</sup> | 30° half angle of threads |
|-------------------|------------------|---------------------|--------|---------------------------------------------------|---------------------------|
|                   |                  | Max                 | Min    |                                                   |                           |
| 1                 | 2                | 3                   | 4      | 5                                                 | 6                         |
| in.               |                  | in./ft              | in./ft | in.                                               | deg ±                     |
| 1/8, 1/8          | 27               | 1/16                | 1/16   | 0.0010                                            | 1                         |
| 1/4, 1/4          | 18               | 1/16                | 1/16   | .0015                                             | 1                         |
| 3/8, 3/8          | 14               | 1/16                | 1/16   | .0020                                             | 1                         |
| 1/2, 1/2, 2       | 11 1/2           | 1/16                | 1/16   | .0025                                             | 3/4                       |
| 3/4, 3/4          | 8                | 1/16                | 1/16   | .0040                                             | 3/4                       |

<sup>a</sup> For sizes 2 1/2 in. and larger, the tolerance on lead shall not exceed 0.003 in. in any inch of thread length. Sizes 1, 1 1/4, 1 1/2, and 2 in. with threads of special length greater than 1 in. shall be subject to same lead tolerance specified for the 2 1/2 in. size.

<sup>b</sup> Length of effective thread is  $L_1$ ,  $L_2$  Short,  $L_1 + L_2$ , or  $L_1$  Short +  $L_2$ , as the case may be.

NOTE.—For tolerances on height of thread see table VIII.2 and for tolerances on pitch diameter see par. 1, p. 19.

TABLE VIII.2.—Limits of size on crest and root truncations of Dryseal American Standard external and internal taper pipe threads for pressuretight joints without lubricant or sealer, NPTF



| Threads per inch | Height of sharp V thread, <i>H</i> | Height of thread, <i>h</i> |         | Truncation, <i>f</i> |        |                |        |           | Equivalent width of flat, <i>F</i> |        |                |        |           |
|------------------|------------------------------------|----------------------------|---------|----------------------|--------|----------------|--------|-----------|------------------------------------|--------|----------------|--------|-----------|
|                  |                                    | Maximum                    | Minimum | Minimum              |        | Maximum        |        | Tolerance | Minimum                            |        | Maximum        |        | Tolerance |
| 1                | 2                                  | 3                          | 4       | 5                    | 6      | 7              | 8      | 9         | 10                                 | 11     | 12             | 13     | 14        |
|                  | in.                                | in.                        | in.     | formula              | in.    | formula        | in.    | in.       | formula                            | in.    | formula        | in.    | in.       |
| 27 Crest.....    | 0.03208                            | 0.02685                    | 0.02426 | 0.047 <i>p</i>       | 0.0017 | 0.094 <i>p</i> | 0.0035 | 0.0018    | 0.054 <i>p</i>                     | 0.0020 | 0.108 <i>p</i> | 0.0040 | 0.0020    |
| 27 Root.....     |                                    |                            |         | .094 <i>p</i>        | .0035  | .140 <i>p</i>  | .0052  | .0017     | .108 <i>p</i>                      | .0040  | .162 <i>p</i>  | .0060  | .0020     |
| 18 Crest.....    | .04811                             | .04117                     | .03856  | .047 <i>p</i>        | .0026  | .078 <i>p</i>  | .0043  | .0017     | .054 <i>p</i>                      | .0030  | .090 <i>p</i>  | .0050  | .0020     |
| 18 Root.....     |                                    |                            |         | .078 <i>p</i>        | .0043  | .109 <i>p</i>  | .0061  | .0018     | .090 <i>p</i>                      | .0050  | .126 <i>p</i>  | .0070  | .0020     |
| 14 Crest.....    | .06186                             | .05500                     | .05236  | .036 <i>p</i>        | .0026  | .060 <i>p</i>  | .0043  | .0017     | .042 <i>p</i>                      | .0030  | .070 <i>p</i>  | .0050  | .0020     |
| 14 Root.....     |                                    |                            |         | .060 <i>p</i>        | .0043  | .085 <i>p</i>  | .0061  | .0018     | .070 <i>p</i>                      | .0050  | .098 <i>p</i>  | .0070  | .0020     |
| 11½ Crest.....   | .07531                             | .06661                     | .06313  | .040 <i>p</i>        | .0035  | .060 <i>p</i>  | .0052  | .0017     | .046 <i>p</i>                      | .0040  | .069 <i>p</i>  | .0060  | .0020     |
| 11½ Root.....    |                                    |                            |         | .060 <i>p</i>        | .0052  | .090 <i>p</i>  | .0078  | .0026     | .069 <i>p</i>                      | .0060  | .103 <i>p</i>  | .0090  | .0030     |
| 8 Crest.....     | .10825*                            | .09613                     | .09275  | .042 <i>p</i>        | .0052  | .055 <i>p</i>  | .0069  | .0017     | .048 <i>p</i>                      | .0060  | .064 <i>p</i>  | .0080  | .0020     |
| 8 Root.....      |                                    |                            |         | .055 <i>p</i>        | .0069  | .076 <i>p</i>  | .0095  | .0026     | .064 <i>p</i>                      | .0080  | .088 <i>p</i>  | .0110  | .0030     |

\* There is reason to doubt the practicability of the 8 tpi flat widths in hard materials on account of the volume of metal to be displaced.

### 3. SPECIFICATIONS FOR TYPE 1, DRYSEAL TAPER PIPE THREAD, NPTF

This series of threads applies to both external and internal threads of full length and is suitable for pipe joints in practically every type of service. These threads are generally conceded to be superior for strength and seal. Use of the internal tapered

thread in hard or brittle materials having thin sections will minimize trouble from fracture.

Dimensional data for these threads are given in table VIII.4. \* Limitation of assembly among the various types of Dryseal standard and SAE SHORT threads shown in this section is given in table VIII.3.

\*TABLE VIII. 3.—Recommended limitation of assembly among the various types of standard Dryseal threads \*\*

[NOTE: This revision does not change the table technically.]

| External Dryseal thread:            |        |                                    | For assembly, with internal Dryseal thread: |        |                                    |
|-------------------------------------|--------|------------------------------------|---------------------------------------------|--------|------------------------------------|
| Type                                | Table  | Description                        | Type                                        | Table  | Description                        |
| 1                                   | 2      | 3                                  | 4                                           | 5      | 6                                  |
| 1.....                              | VIII.4 | NPTF (tapered), ext. thd.          | 1.....                                      | VIII.4 | NPTF (tapered), int. thd.          |
|                                     |        |                                    | 2 <sup>b</sup> , <sup>c</sup> .....         | VIII.6 | PTF-SAE SHORT (tapered), int. thd. |
|                                     |        |                                    | 3 <sup>a</sup> .....                        | VIII.7 | NPSF (straight), int. thd.         |
|                                     |        |                                    | 4 <sup>a</sup> , <sup>f</sup> .....         | VIII.8 | NPSI (straight), int. thd.         |
| 2 <sup>b</sup> , <sup>c</sup> ..... | VIII.5 | PTF-SAE SHORT (tapered), ext. thd. | 4.....                                      | VIII.8 | NPSI (straight), int. thd.         |
|                                     |        |                                    | 1.....                                      | VIII.4 | NPTF (tapered), int. thd.          |

\* Interchangeability between Dryseal threads shown in this section and Dryseal special threads, PTF-SPL SHORT and PTF-SPL EXTRA SHORT, is given in table 7.9, p. 109. An assembly with straight internal pipe threads and taper external pipe threads is frequently more advantageous than an all taper thread assembly, particularly in automotive and other allied industries where economy and rapid production are paramount considerations. Dryseal threads are not used in assemblies in which both components have straight pipe threads.

\* Trouble-free assemblies and pressure-tight joints without the use of lubricant or sealer can best be assured where both components are threaded with NPTF (full length) threads. This should be considered before specifying PTF-SAE external or internal threads.

\* PTF-SAE SHORT external threads are primarily intended for assembly with type 4 NPSI internal threads but can also be used with type 1 NPTF

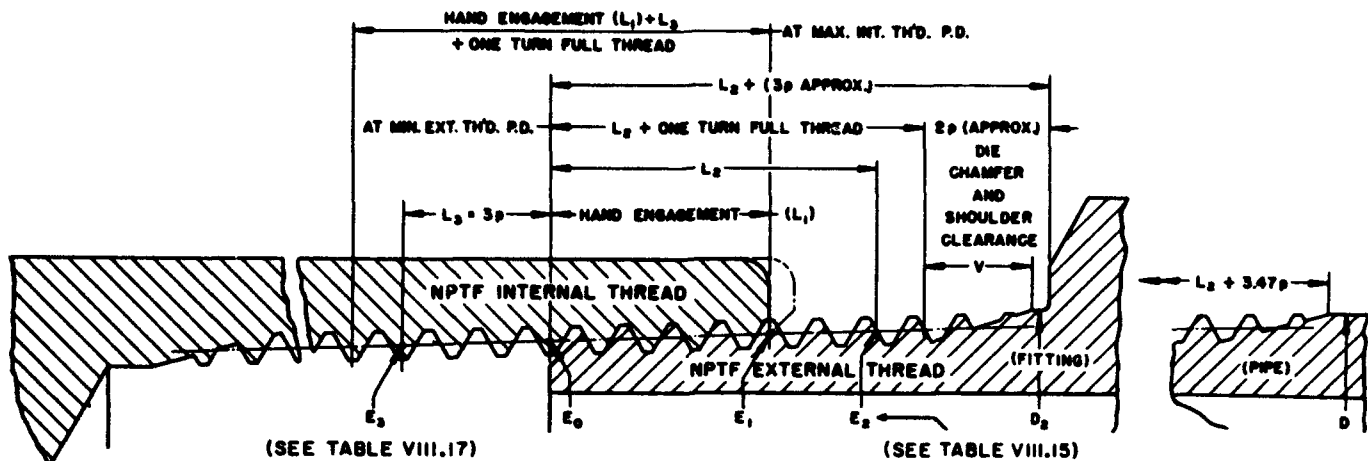
internal threads. They are not designed for, and at extreme tolerance limits may not assemble with, type 2 PTF-SAE SHORT internal threads or type 3 NPSF internal threads.

\* PTF-SAE SHORT internal threads are primarily intended for assembly with type 1 NPTF external threads. They are not designed for, and at extreme tolerance limits may not assemble with, type 2 PTF-SAE SHORT external threads.

\* There is no external thread for the NPSF or NPSI types of threads. NPSI internal threads are primarily intended for assembly with type 2 PTF-SAE SHORT external threads but will also assemble with full length type 1 NPTF external threads.

\*\* See table 7.9, p. 109, for limitation of assembly with other series Dryseal threads.

TABLE VIII.4.—Basic dimensions of Dryseal American Standard taper pipe thread, NPTF \*



| Size         | Pitch, <i>p</i> | Pitch diameter at end of external thread, <i>E</i> <sub>2</sub> <sup>d</sup> | Pitch diameter at end of internal thread, <i>E</i> <sub>1</sub> <sup>d</sup> | Hand engagement, <i>L</i> <sub>1</sub> |                       | External basic full thread length, <i>L</i> <sub>2</sub> |                       | Vanish thds, <i>V</i> , plus full thd tolerance plus shoulder clearance, ( <i>V</i> + 3 <i>p</i> /2) |                       | Shoulder length, ( <i>L</i> <sub>2</sub> + 3 <i>p</i> , approx.) | External thread for draw, ( <i>L</i> <sub>2</sub> - <i>L</i> <sub>1</sub> ) |                       | Internal basic full thread length, ( <i>L</i> <sub>1</sub> + <i>L</i> <sub>2</sub> ) |                       | Outside diameter of fitting, <i>D</i> <sub>2</sub> | Outside diameter of pipe, <i>D</i> |
|--------------|-----------------|------------------------------------------------------------------------------|------------------------------------------------------------------------------|----------------------------------------|-----------------------|----------------------------------------------------------|-----------------------|------------------------------------------------------------------------------------------------------|-----------------------|------------------------------------------------------------------|-----------------------------------------------------------------------------|-----------------------|--------------------------------------------------------------------------------------|-----------------------|----------------------------------------------------|------------------------------------|
|              |                 |                                                                              |                                                                              | <i>L</i> <sub>1</sub>                  | <i>L</i> <sub>2</sub> | <i>L</i> <sub>1</sub>                                    | <i>L</i> <sub>2</sub> | <i>L</i> <sub>1</sub>                                                                                | <i>L</i> <sub>2</sub> |                                                                  | <i>L</i> <sub>1</sub>                                                       | <i>L</i> <sub>2</sub> | <i>L</i> <sub>1</sub>                                                                | <i>L</i> <sub>2</sub> |                                                    |                                    |
| 1            | 2               | 3                                                                            | 4                                                                            | 5                                      | 6                     | 7                                                        | 8                     | 9                                                                                                    | 10                    | 11                                                               | 12                                                                          | 13                    | 14                                                                                   | 15                    | 16                                                 | 17                                 |
| 1/8-27       | .03704          | .27118                                                                       | .28118                                                                       | .160                                   | 4.32                  | .2611                                                    | 7.06                  | .1139                                                                                                | 3.075                 | .3750                                                            | .1011                                                                       | 2.73                  | .2711                                                                                | 7.32                  | .315                                               | .3125                              |
| 1/4-27       | .03704          | .36351                                                                       | .37360                                                                       | .1615                                  | 4.36                  | .2639                                                    | 7.12                  | .1112                                                                                                | 3.072                 | .3750                                                            | .1024                                                                       | 2.76                  | .2726                                                                                | 7.36                  | .407                                               | .405                               |
| 3/8-18       | .05556          | .47739                                                                       | .49163                                                                       | .2278                                  | 4.10                  | .4018                                                    | 7.23                  | .1807                                                                                                | 2.892                 | .5625                                                            | .1740                                                                       | 3.13                  | .3945                                                                                | 7.10                  | .546                                               | .540                               |
| 1/2-14       | .05556          | .61201                                                                       | .62701                                                                       | .240                                   | 4.32                  | .4078                                                    | 7.34                  | .1547                                                                                                | 2.791                 | .5625                                                            | .1678                                                                       | 3.02                  | .4067                                                                                | 7.32                  | .681                                               | .675                               |
| 5/8-14       | .07143          | .75843                                                                       | .77843                                                                       | .320                                   | 4.48                  | .5337                                                    | 7.47                  | .2163                                                                                                | 3.028                 | .7500                                                            | .2137                                                                       | 2.99                  | .5343                                                                                | 7.48                  | .850                                               | .840                               |
| 3/4-14       | .07143          | .96708                                                                       | .98857                                                                       | .339                                   | 4.75                  | .5457                                                    | 7.64                  | .2043                                                                                                | 2.960                 | .7500                                                            | .2067                                                                       | 2.99                  | .5533                                                                                | 7.75                  | 1.090                                              | 1.050                              |
| 1-11 1/2     | .08996          | 1.21363                                                                      | 1.23963                                                                      | .400                                   | 4.60                  | .6826                                                    | 7.85                  | .2347                                                                                                | 2.929                 | .9375                                                            | .2828                                                                       | 3.25                  | .6609                                                                                | 7.60                  | 1.327                                              | 1.315                              |
| 1 1/4-11 1/2 | .08996          | 1.55713                                                                      | 1.58338                                                                      | .420                                   | 4.83                  | .7068                                                    | 8.13                  | .2620                                                                                                | 3.013                 | .9375                                                            | .2868                                                                       | 3.30                  | .6809                                                                                | 7.83                  | 1.672                                              | 1.660                              |
| 1 1/2-11 1/2 | .08996          | 1.79809                                                                      | 1.82234                                                                      | .420                                   | 4.83                  | .7235                                                    | 8.32                  | .2765                                                                                                | 3.180                 | 1.0000                                                           | .3035                                                                       | 3.49                  | .6809                                                                                | 7.83                  | 1.912                                              | 1.900                              |
| 2-11 1/2     | .08996          | 2.26902                                                                      | 2.29627                                                                      | .436                                   | 5.01                  | .7565                                                    | 8.70                  | .2747                                                                                                | 3.159                 | 1.0312                                                           | .3205                                                                       | 3.69                  | .6999                                                                                | 8.01                  | 2.387                                              | 2.375                              |
| 2 1/2-8      | .12500          | 2.71953                                                                      | 2.76216                                                                      | .682                                   | 5.46                  | 1.1375                                                   | 9.10                  | .3781                                                                                                | 3.025                 | 1.5156                                                           | .4555                                                                       | 3.64                  | 1.0570                                                                               | 8.46                  | 2.863                                              | 2.875                              |
| 3-8          | .12500          | 3.34062                                                                      | 3.38850                                                                      | .766                                   | 6.13                  | 1.2000                                                   | 9.60                  | .3781                                                                                                | 3.025                 | 1.5781                                                           | .4340                                                                       | 3.47                  | 1.1410                                                                               | 9.13                  | 3.518                                              | 3.500                              |

\* See general specifications preceding tables and table VIII.3. For drilled hole sizes see appendix 7, p. 104.

<sup>b</sup> Tabulated external basic full thread lengths include chamfers not exceeding one and one-half pitches (threads) length. Design size full thread length should equal the external basic full thread length plus one pitch.

<sup>c</sup> Tabulated internal basic full thread lengths do not include countersink beyond the intersection of the pitch line and the chamfer cone (gaging reference point).

Design size full thread length should equal the internal basic full thread length plus one pitch.

$$E_2 = D - (0.06D + 1.1)p$$

$$E_1 = E_2 + 0.0625L_1$$

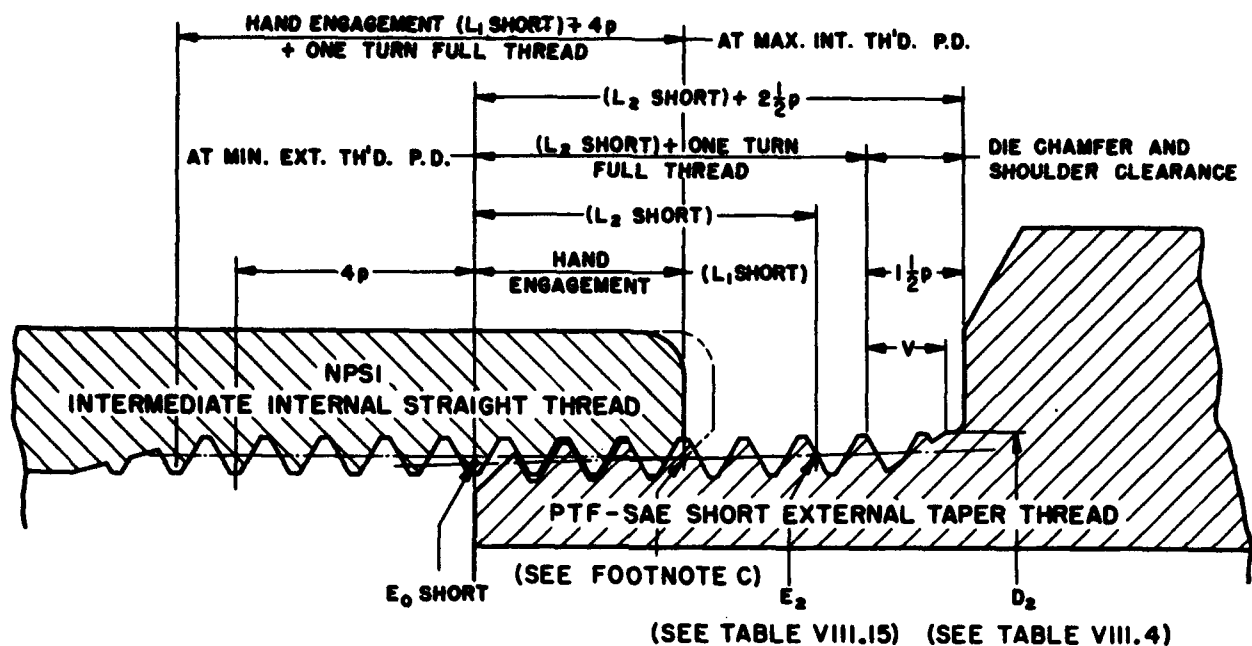
$$L_2 = (0.8D + 6.8)p$$

#### 4. SPECIFICATIONS FOR TYPE 2, DRYSEAL TAPER PIPE THREAD, PTF-SAE SHORT, EXTERNAL

External threads of this series conform in all respects with the NPTF threads except that the full thread length has been shortened by eliminating one thread at the small end for increased clearance and economy of material.

Dimensional data for these threads are given in table VIII.5. Interchangeability between the various types of Dryseal Standard and SAE SHORT threads is given in table VIII.3. Interchangeability between the PTF-SAE SHORT, External thread and Dryseal special threads, PTF-SPL SHORT and PTF-SPL EXTRA SHORT, is given in table 7.9, p. 109.

TABLE VIII.5.—Basic dimensions of Dryseal SAE Short External taper pipe thread, PTF-SAE SHORT, External \*



| Size         | Pitch, $p$ | Pitch diameter at end of external thread, $L_0$ short | $L_1$  |      | Hand engagement, $L_1$ short |      | External * basic full thread length, $L_2$ short |      | Vanish thds, $V$ , plus full thd toler plus shoulder clearance, $(V + 3p/2)$ |      | Minimum shoulder length, $(L_2$ short $+ 2\frac{1}{2}p$ ) |        | External thread for draw, $(L_2$ short $- L_1$ short) |        | Internal * basic full thread length, $(L_1$ short $+ 4p)$ |  |
|--------------|------------|-------------------------------------------------------|--------|------|------------------------------|------|--------------------------------------------------|------|------------------------------------------------------------------------------|------|-----------------------------------------------------------|--------|-------------------------------------------------------|--------|-----------------------------------------------------------|--|
| 1            | 2          | 3                                                     | 4      | 5    | 6                            | 7    | 8                                                | 9    | 10                                                                           | 11   | 12                                                        | 13     | 14                                                    | 15     | 16                                                        |  |
|              | in.        | in.                                                   | in.    | thds | in.                          | thds | in.                                              | thds | in.                                                                          | thds | in.                                                       | in.    | thds                                                  | in.    | thds                                                      |  |
| 1/8-27       | 0.03704    | 0.27349                                               | 0.160  | 4.32 | 0.1230                       | 3.32 | 0.2241                                           | 6.05 | 0.0926                                                                       | 2.50 | 0.3167                                                    | 0.1011 | 2.73                                                  | 0.2711 | 7.32                                                      |  |
| 1/8-27       | 0.03704    | 0.26582                                               | 0.1615 | 4.36 | 0.1244                       | 3.36 | 0.2268                                           | 6.12 | 0.0926                                                                       | 2.50 | 0.3194                                                    | 0.1024 | 2.76                                                  | 0.2726 | 7.36                                                      |  |
| 1/4-18       | 0.05556    | 0.48086                                               | 0.2278 | 4.10 | 0.1722                       | 3.10 | 0.3462                                           | 6.23 | 0.1389                                                                       | 2.50 | 0.4851                                                    | 0.1740 | 3.13                                                  | 0.3945 | 7.10                                                      |  |
| 1/4-18       | 0.05556    | 0.45488                                               | 0.240  | 4.32 | 0.1844                       | 3.32 | 0.3522                                           | 6.34 | 0.1389                                                                       | 2.50 | 0.4911                                                    | 0.1678 | 3.02                                                  | 0.4067 | 7.32                                                      |  |
| 1/2-14       | 0.07143    | 0.76289                                               | 0.320  | 4.48 | 0.2486                       | 3.48 | 0.4623                                           | 6.47 | 0.1786                                                                       | 2.50 | 0.6409                                                    | 0.2137 | 2.99                                                  | 0.5343 | 7.48                                                      |  |
| 1/2-14       | 0.07143    | 0.7214                                                | 0.339  | 4.75 | 0.2676                       | 3.75 | 0.4743                                           | 6.64 | 0.1786                                                                       | 2.50 | 0.6528                                                    | 0.2067 | 2.89                                                  | 0.5533 | 7.75                                                      |  |
| 1-11 1/2     | 0.08696    | 1.21906                                               | 0.400  | 4.60 | 0.3130                       | 3.60 | 0.5958                                           | 6.85 | 0.2174                                                                       | 2.50 | 0.8132                                                    | 0.2828 | 3.25                                                  | 0.6909 | 7.60                                                      |  |
| 1 1/4-11 1/2 | 0.08696    | 1.56256                                               | 0.420  | 4.83 | 0.3330                       | 3.83 | 0.6198                                           | 7.13 | 0.2174                                                                       | 2.50 | 0.8372                                                    | 0.2968 | 3.30                                                  | 0.6909 | 7.83                                                      |  |
| 1 1/2-11 1/2 | 0.08696    | 1.80152                                               | 0.420  | 4.83 | 0.3330                       | 3.83 | 0.6365                                           | 7.32 | 0.2174                                                                       | 2.50 | 0.8539                                                    | 0.3035 | 3.49                                                  | 0.6909 | 7.83                                                      |  |
| 2-11 1/2     | 0.08696    | 2.27445                                               | 0.436  | 5.01 | 0.3490                       | 4.01 | 0.6685                                           | 7.70 | 0.2174                                                                       | 2.50 | 0.8869                                                    | 0.3205 | 3.69                                                  | 0.6969 | 8.01                                                      |  |
| 2 1/2-8      | 0.12500    | 2.72734                                               | 0.682  | 5.46 | 0.5570                       | 4.46 | 1.0125                                           | 8.10 | 0.3125                                                                       | 2.50 | 1.3250                                                    | 0.4555 | 3.64                                                  | 1.0570 | 8.46                                                      |  |
| 3-8          | 0.12500    | 3.34944                                               | 0.706  | 6.13 | 0.6410                       | 5.13 | 1.0750                                           | 8.60 | 0.3125                                                                       | 2.50 | 1.3875                                                    | 0.4340 | 3.47                                                  | 1.1410 | 9.13                                                      |  |

\* See general specifications preceding tables and table VIII.3. For drilled hole sizes see appendix 7, p. 104.

\* Tabulated external basic full thread lengths include chamfers not exceeding one \* and one-half pitches (threads) length. Design size full thread length should equal the external basic full thread length plus one pitch.

\* Tabulated internal basic full thread lengths do not include countersink beyond the intersection of the pitch line and the chamfer cone (gaging refer-

ence point). Design size full thread length should equal the internal basic full thread length plus one pitch.

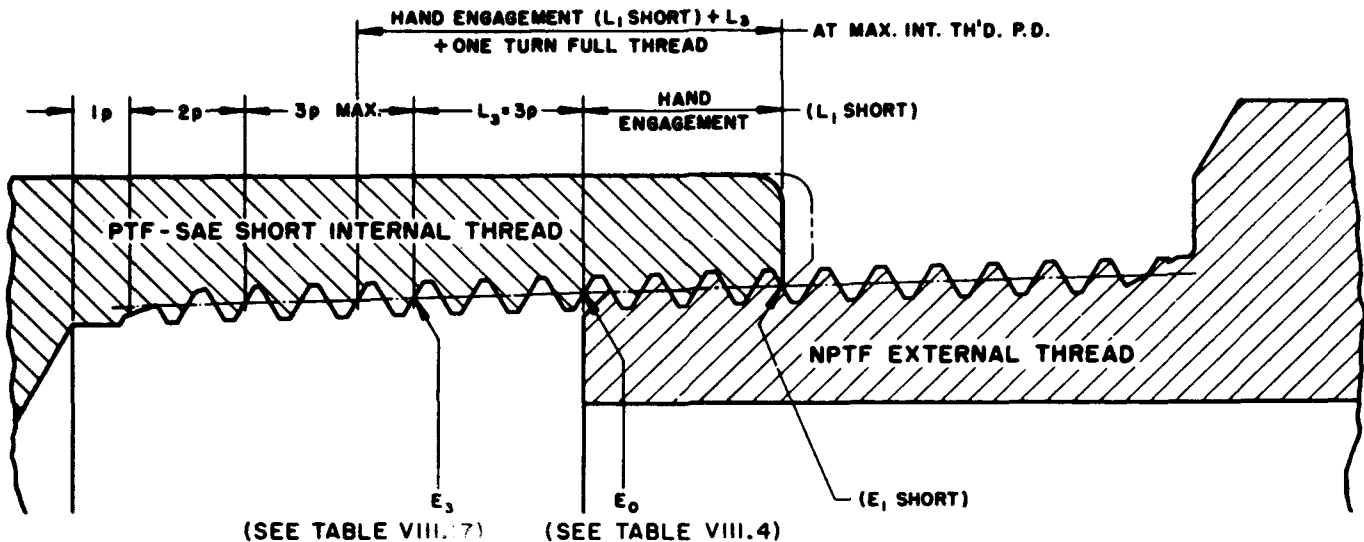
\*  $E_0$  short =  $D - (0.05D + 1.037)p$   
 $L_2$  short =  $(0.8D + 5.8)p$

# 5. SPECIFICATIONS FOR TYPE 2, DRYSEAL TAPER PIPE THREAD, PTF-SAE SHORT, IN- TERNAL

Internal threads of this series conform in all respects with NPTF threads except that the full thread length has been shortened by eliminating one thread at the large end.

Dimensional data for these threads are given in table VIII.6. Interchangeability between the various types of Dryseal standard and SAE SHORT threads is given in table VIII.3. Interchangeability between the PTF-SAE SHORT, Internal thread and Dryseal special threads, PTF-SPL SHORT and PTF-SPL EXTRA SHORT, is given in table 7.9, p. 109.

TABLE VIII.6.—Basic dimensions of Dryseal SAE Short Internal taper pipe thread, PTF-SAE SHORT, Internal \*



| Size         | Pitch, $p$ | Pitch diameter at end of int thread, $E_1$ short * | $L_1$ |      | Hand engagement, $L_1$ short |      | Internal basic * full thread length, ( $L_1$ short + $L_3$ ) |      | Hole depth for SAE short tap |
|--------------|------------|----------------------------------------------------|-------|------|------------------------------|------|--------------------------------------------------------------|------|------------------------------|
| 1            | 2          | 3                                                  | 4     | 5    | 6                            | 7    | 8                                                            | 9    | 10                           |
|              | in.        | in.                                                | in.   | thds | in.                          | thds | in.                                                          | thds | in.                          |
| 1/16-27      | 0.03704    | 0.27887                                            | 0.160 | 4.32 | 0.1230                       | 3.32 | 0.2341                                                       | 6.32 | 0.4564                       |
| 1/8-27       | .03704     | .37129                                             | .1615 | 4.36 | .1244                        | 3.36 | .2356                                                        | 6.36 | .4578                        |
| 1/4-18       | .05556     | .48815                                             | .2278 | 4.10 | .1722                        | 3.10 | .3389                                                        | 6.10 | .6722                        |
| 3/8-18       | .05556     | .62354                                             | .240  | 4.32 | .1844                        | 3.32 | .3511                                                        | 6.32 | .6844                        |
| 1/2-14       | .07143     | .77397                                             | .320  | 4.48 | .2486                        | 3.48 | .4629                                                        | 6.48 | .8915                        |
| 3/4-14       | .07143     | .98441                                             | .339  | 4.75 | .2676                        | 3.75 | .4819                                                        | 6.75 | .9105                        |
| 1-11 1/2     | .08686     | 1.23320                                            | .400  | 4.60 | .3130                        | 3.60 | .5739                                                        | 6.60 | 1.0956                       |
| 1 1/4-11 1/2 | .08686     | 1.57795                                            | .420  | 4.83 | .3330                        | 3.83 | .5939                                                        | 6.83 | 1.1156                       |
| 1 1/2-11 1/2 | .09696     | 1.81691                                            | .420  | 4.83 | .3330                        | 3.83 | .5939                                                        | 6.83 | 1.1156                       |
| 2-11 1/2     | .08686     | 2.29084                                            | .436  | 5.01 | .3490                        | 4.01 | .6099                                                        | 7.01 | 1.1316                       |
| 2 1/2-8      | .12500     | 2.75435                                            | .682  | 5.46 | .5570                        | 4.46 | .9320                                                        | 7.46 | 1.6820                       |
| 3-8          | .12500     | 3.39089                                            | .766  | 6.13 | .6410                        | 5.13 | 1.0160                                                       | 8.13 | 1.7660                       |

\* See general specifications preceding tables and table VIII. 3. For drilled hole sizes see appendix 7, p. 104.

\* Tabulated internal basic full thread lengths do not include countersink beyond the intersection of the pitch line and the chamfer cone (gaging reference point).

Design size full thread length should equal the internal basic full thread length plus one pitch.

\*  $E_1$  short =  $E_0$  short + 0.0625  $L_1$  short.

## 6. SPECIFICATIONS FOR TYPE 3, DRYSEAL FUEL INTERNAL STRAIGHT PIPE THREAD, NPSF

Threads of this series are straight (cylindrical) instead of tapered. They are generally used in soft or ductile materials which will adjust at assembly to the taper of external threads but may also be used in hard or brittle materials where the section is heavy.

Dimensional data for these threads are given in table VIII.7. Interchangeability between the various types of Dryseal standard and SAE SHORT threads is given in table VIII.3. Interchangeability between the NPSF thread and Dryseal special threads, PTF-SPL SHORT and PTF-SPL EXTRA SHORT, is given in table 7.9, p. 109.

TABLE VIII.7.—Dryseal American Standard fuel internal straight pipe thread limits, NPSF<sup>a</sup>

| Size     | Pitch diameter <sup>b</sup> |                    | Minor <sup>c</sup><br>diameter | Design size <sup>e</sup><br>minimum length<br>of full thread |              |
|----------|-----------------------------|--------------------|--------------------------------|--------------------------------------------------------------|--------------|
|          | Max <sup>d,e</sup>          | Min <sup>d,f</sup> | Min                            |                                                              |              |
| 1        | 2                           | 3                  | 4                              | 5                                                            | 6            |
|          | <i>in.</i>                  | <i>in.</i>         | <i>in.</i>                     | <i>in.</i>                                                   | <i>thds.</i> |
| 1/16-27  | 0.2803                      | 0.2768             | 0.2482                         | 5/16                                                         | 8.44         |
| 1/8-27   | .3727                       | .3692              | .3406                          | 5/16                                                         | 8.44         |
| 1/4-18   | .4904                       | .4852              | .4422                          | 1 1/32                                                       | 8.44         |
| 3/8-18   | .6257                       | .6205              | .5776                          | 1/2                                                          | 9.00         |
| 1/2-14   | .7767                       | .7700              | .7133                          | 2 1/32                                                       | 9.19         |
| 3/4-14   | .9672                       | .9605              | .9238                          | 2 1/32                                                       | 9.19         |
| 1-11 1/2 | 1.2365                      | 1.2284             | 1.1600                         | 2 1/32                                                       | 8.98         |

<sup>a</sup> See general specifications preceding the tables and table VIII.3. For drilled hole sizes see appendix 7, p. 104.

<sup>b</sup> The pitch diameter of the tapped hole as indicated by the taper plug gage is slightly larger than the values given due to the gage having to enter approximately 3/8 turn to engage first full thread.

<sup>c</sup> As the Dryseal American Standard pipe thread form is maintained, the major and minor diameters of the internal thread vary with the pitch diameter.

<sup>d</sup> Col. 2 is the same as the E<sub>1</sub> pitch diameter of thread at large end of internal thread (table VIII.4) minus (small) 3/8 thread taper.

<sup>e</sup> Taps that produce tapped holes to the above limits in cast iron, steel, and brass will produce tapped holes approximately 0.001 in. smaller in zinc and similar soft metals. Plug-gage turns engagement should be reduced accordingly.

<sup>f</sup> Column 3 is column 2 reduced by 1 1/2 turns.

<sup>g</sup> Tabulated internal full thread lengths do not include countersink beyond the intersection of the pitch line and the chamfer cone (gaging reference point).

## 7. SPECIFICATIONS FOR TYPE 4, DRYSEAL INTERMEDIATE INTERNAL STRAIGHT PIPE THREAD, NPSI

Threads of this series are straight (cylindrical) instead of tapered. They are generally used in hard or brittle materials where the section is heavy and where there is little expansion at assembly with the external taper threads.

Dimensional data for these threads are given in table VIII.8. Interchangeability between the various types of Dryseal threads is given in table VIII.3. Interchangeability between the NPSI thread and Dryseal special threads, PTF-SPL SHORT and PTF-SPL EXTRA SHORT is given in table 7.9, p. 109.

TABLE VIII.8.—Dryseal American Standard intermediate internal straight pipe thread limits, NPSI<sup>a</sup>

| Size     | Pitch diameter <sup>b</sup> |                    | Minor <sup>c</sup><br>diameter | Design size <sup>e</sup><br>minimum length of full<br>thread |              |
|----------|-----------------------------|--------------------|--------------------------------|--------------------------------------------------------------|--------------|
|          | Max <sup>d,e</sup>          | Min <sup>d,f</sup> | Min                            |                                                              |              |
| 1        | 2                           | 3                  | 4                              | 5                                                            | 6            |
|          | <i>in.</i>                  | <i>in.</i>         | <i>in.</i>                     | <i>in.</i>                                                   | <i>thds.</i> |
| 1/16-27  | 0.2826                      | 0.2791             | 0.2505                         | 5/16                                                         | 8.44         |
| 1/8-27   | .3750                       | .3715              | .3429                          | 5/16                                                         | 8.44         |
| 1/4-18   | .4938                       | .4886              | .4457                          | 1 1/32                                                       | 8.44         |
| 3/8-18   | .6292                       | .6240              | .5811                          | 1/2                                                          | 9.00         |
| 1/2-14   | .7812                       | .7745              | .7180                          | 2 1/32                                                       | 9.19         |
| 3/4-14   | .9917                       | .9850              | .9283                          | 2 1/32                                                       | 9.19         |
| 1-11 1/2 | 1.2420                      | 1.2338             | 1.1655                         | 2 1/32                                                       | 8.98         |

<sup>a</sup> See general specifications preceding tables and table VIII.3. For drilled hole sizes see appendix 7, p. 104.

<sup>b</sup> The pitch diameter of the tapped hole as indicated by the taper plug gage is slightly larger than the values given due to the gage having to enter approximately 3/8 turn to engage first full thread.

<sup>c</sup> As the Dryseal American Standard pipe thread form is maintained, the major and minor diameters of the internal thread vary with the pitch diameter.

<sup>d</sup> Column 2 is the E<sub>1</sub> pitch diameter of thread at large end of internal thread (table VIII.4) plus (large) 5/8 thread taper.

<sup>e</sup> Taps that produce tapped holes to the above limits in cast iron, steel, and brass will produce tapped holes approximately 0.001 in. smaller in zinc and similar soft metals. Plug-gage turns engagement should be reduced accordingly.

<sup>f</sup> Column 3 is column 2 reduced by 1 1/2 turns.

<sup>g</sup> Internal thread tabulated full thread lengths do not include countersink beyond the intersection of the pitch line and the chamfer cone (gaging reference point).

## 8. GAGES AND GAGE TOLERANCES

1. DESIGN OF GAGES.—Gages for Dryseal pipe threads should conform with the dimensions for the gages shown herein. The thread form shall conform to that specified in par. 2, p. 18 except that crests of the threads on the plug and ring gages shall be truncated  $0.20p$  to  $0.25p$ . These truncations will be as shown in table VIII.9. The form of the root clearance for the gages is optional. Tolerances on dimensions other than truncation shall conform to those specified in table VIII.10.

2. RELATION OF LEAD AND ANGLE DEVIATIONS TO PITCH DIAMETER TOLERANCES OF GAGES.—When it is necessary to compute from measurements the decimal part of a turn that a gage varies from the basic dimensions, which is required for master and reference gages, tables VII.11 and VII.12, p. 16, should be used. Table VII.11 gives the corrections in diameter equivalents for angle deviations and table VII.12 gives the diameter equivalents for lead deviations. These values are always added to the pitch diameter in the case of external threads and subtracted in the case of internal threads regardless of whether or not the lead or angle deviations are plus or minus.

The diameter equivalents for lead and angle deviations plus the pitch diameter\* deviation multiplied by 16 gives the longitudinal variation from basic at the gaging notch. This longitudinal variation divided by the pitch equals the decimal part of a turn that the gage varies from basic at the gaging notch.

3. GAGING OF DRYSEAL PIPE THREADS.—The three accepted methods of gaging Dryseal pipe threads with threaded plug and ring gages are:

(a) Position method of gaging with basic-notch gages,

(b) Limit method of gaging with step-limit gages, and

(c) Turns-engagement method of gaging with basic-notch or step-limit gages.

All methods of gaging external Dryseal threads involve the use of two ring thread gages, the ( $L_1$ ) thin-ring thread gage for checking the virtual diameter over the hand engagement of ( $L_1$ ) thread length and the ( $L_2$ ) full ring gage for checking the virtual diameter over the remainder of the full thread length and the taper over the full thread length.

All methods of gaging internal Dryseal threads involve the use of two plug thread gages, the ( $L_1$ ) plug thread gage for checking the virtual diameter over the hand engagement or ( $L_1$ ) thread length and the ( $L_2$ ) plug thread gage for checking virtual

TABLE VIII.9.—Crest truncation of threads of Dryseal pipe thread gages

| Threads per inch | Truncation |            |
|------------------|------------|------------|
|                  | Max        | Min        |
| 1                | 2          | 3          |
|                  | <i>in.</i> | <i>in.</i> |
| 27.....          | 0.0093     | 0.0074     |
| 18.....          | .0139      | .0111      |
| 14.....          | .0179      | .0143      |
| 11½.....         | .0217      | .0174      |
| 8.....           | .0312      | .0250      |

TABLE VIII.10.—Tolerances for reference and inspection (working) plug and ring gages, NPTF

| Nominal pipe size | Threads per inch | Tolerance on pitch diameter * | Tolerance on lead <sup>b,c</sup> |        | Tolerance on half angle <sup>c</sup> |       | Tolerance on taper <sup>d,e</sup> |        | Tolerance on major diameter <sup>f</sup> | Tolerance on minor diameter <sup>g</sup> | Total cumulative tolerances on pitch diameter |         | Standoff between plug and ring gages at gaging notch for dimensions at opposite extreme tolerance limits <sup>h</sup> |
|-------------------|------------------|-------------------------------|----------------------------------|--------|--------------------------------------|-------|-----------------------------------|--------|------------------------------------------|------------------------------------------|-----------------------------------------------|---------|-----------------------------------------------------------------------------------------------------------------------|
|                   |                  |                               | Plugs                            | Rings  | Plugs                                | Rings | Plugs                             | Rings  |                                          |                                          | Plugs                                         | Rings   |                                                                                                                       |
| 1                 | 2                | 3                             | 4                                | 5      | 6                                    | 7     | 8                                 | 9      | 10                                       | 11                                       | 12                                            | 13      | 14                                                                                                                    |
| in.               |                  | in.                           | in.                              | in.    | min ±                                | min ± | in.                               | in.    | in.                                      | in.                                      | in.                                           | in.     | in.                                                                                                                   |
| 3/16              | 27               | 0.0002                        | 0.0002                           | 0.0008 | 15                                   | 20    | 0.0008                            | 0.0006 | 0.0019                                   | 0.0019                                   | 0.00080                                       | 0.00118 | 0.002                                                                                                                 |
| 1/4               | 27               | 0.0002                        | 0.0002                           | 0.0008 | 15                                   | 20    | 0.0008                            | 0.0006 | 0.0019                                   | 0.0019                                   | 0.00080                                       | 0.00118 | 0.002                                                                                                                 |
| 5/16              | 18               | 0.0002                        | 0.0002                           | 0.0008 | 15                                   | 20    | 0.0004                            | 0.0007 | 0.0028                                   | 0.0028                                   | 0.00092                                       | 0.00134 | 0.006                                                                                                                 |
| 3/8               | 18               | 0.0002                        | 0.0002                           | 0.0008 | 15                                   | 20    | 0.0004                            | 0.0007 | 0.0028                                   | 0.0028                                   | 0.00092                                       | 0.00134 | 0.006                                                                                                                 |
| 1/2               | 14               | 0.0003                        | 0.0002                           | 0.0008 | 10                                   | 15    | 0.0006                            | 0.0009 | 0.0036                                   | 0.0036                                   | 0.00097                                       | 0.00142 | 0.008                                                                                                                 |
| 3/4               | 14               | 0.0003                        | 0.0002                           | 0.0008 | 10                                   | 15    | 0.0006                            | 0.0009 | 0.0036                                   | 0.0036                                   | 0.00097                                       | 0.00142 | 0.008                                                                                                                 |
| 1                 | 11 1/2           | 0.0003                        | 0.0003                           | 0.0004 | 10                                   | 15    | 0.0008                            | 0.0012 | 0.0043                                   | 0.0043                                   | 0.00121                                       | 0.00170 | 0.047                                                                                                                 |
| 1 1/4             | 11 1/2           | 0.0003                        | 0.0003                           | 0.0004 | 10                                   | 15    | 0.0008                            | 0.0012 | 0.0043                                   | 0.0043                                   | 0.00121                                       | 0.00170 | 0.047                                                                                                                 |
| 1 1/2             | 11 1/2           | 0.0003                        | 0.0003                           | 0.0004 | 10                                   | 15    | 0.0008                            | 0.0012 | 0.0043                                   | 0.0043                                   | 0.00121                                       | 0.00170 | 0.047                                                                                                                 |
| 2                 | 11 1/2           | 0.0003                        | 0.0003                           | 0.0004 | 10                                   | 15    | 0.0008                            | 0.0012 | 0.0043                                   | 0.0043                                   | 0.00121                                       | 0.00170 | 0.047                                                                                                                 |
| 2 1/2             | 8                | 0.0006                        | 0.0004                           | 0.0005 | 7                                    | 10    | 0.0010                            | 0.0014 | 0.0062                                   | 0.0062                                   | 0.00156                                       | 0.00211 | 0.050                                                                                                                 |
| 3                 | 8                | 0.0006                        | 0.0004                           | 0.0005 | 7                                    | 10    | 0.0010                            | 0.0014 | 0.0062                                   | 0.0062                                   | 0.00156                                       | 0.00211 | 0.050                                                                                                                 |

\* To be measured at the gaging notch of plug gage.

<sup>b</sup> Allowable variation in lead between any two threads in  $L_1$  length of gage.

<sup>c</sup> In solving for the correction in diameter for angle deviations, the average deviation in half angle for the two sides of thread regardless of their signs should be taken.

<sup>d</sup> The lead and taper on plug and ring gages shall be measured along the pitch line, omitting the imperfect threads at each end.

<sup>e</sup> Allowable variation in taper in  $L_1$  length of gage.

<sup>f</sup> Tolerance on major diameter of plug gage at gaging notch.

<sup>g</sup> Tolerance on minor diameter of ring gage at large end.

<sup>h</sup> Maximum possible interchange standoff, any ring against any plug other

than its master plug, may occur when taper deviations are zero and all other dimensions are at opposite extreme tolerance limits. Average standoff should be well within these maximum limits.

NOTE.—The tolerances for the length  $L_1$  from small end to gaging notch of the plug gage shall be +0.000 and -0.001 for sizes 3/16 to 2 in., inclusive, and +0.000 and -0.002 for sizes 2 1/2 in. and larger. The tolerances for the overall thread length  $L_2$  of the plug gage shall be +0.005 and -0.000 for sizes 3/16 to 2 in., inclusive, and +0.010 and -0.000 for sizes 2 1/2 in. and larger. Tolerances for the thickness  $L_1$  of the ring gage shall be -0.000 and +0.001 for sizes 3/16 to 2 in., incl., and -0.000 and +0.002 for sizes 2 1/2 in. and larger.

diameter of the thread beyond the hand engagement length and taper over the full thread length.

As indicated in the separate descriptions of the various gaging methods, coordination of the two ring thread gages for external threads and coordination of the two plug thread gages for internal threads control and check thread taper and length. The gages cannot be correlated, however, for external threads of minimum virtual diameter or internal threads of maximum virtual diameter unless the design size full thread length of the threads is one thread longer than basic full thread length.

Inspection (working) gages should not be used if worn beyond the basic dimensions by more than 1/2 turn (thread). It is recommended that the standoff from the reference gage be determined for each inspection (working) gage and that values be taken into consideration when the gage is used. All gages for Dryseal threads should be kept under careful surveillance and the standoff value revised as the gage wears.

The threads of tools and the threads of a percentage of the product or casts in the case of internal threads should be projected as a check on thread form and truncation. Although projection is strongly recommended, the truncation at major diameter of internal thread and minor diameter of external thread may be checked respectively with special plug and ring gages with thread angle reduced to clear the flank of the threads; and the truncation at minor diameter of internal taper thread and major diameter of external taper thread may be checked respectively

with plain taper plug gages and plain taper ring gages. Internal straight thread truncation at minor diameter may be checked with plain\* cylindrical plug gages.

(a) *Position method of gaging with basic-notch gages.*—The position method of gaging Dryseal threads with plug thread and ring thread gages is a visual check of the position of the gages in relation to the product. It involves estimating the position of a notch or step on the thread gages in relation to the gaging point of the product within the allowable tolerance.

While the method is the same as that used for years past in checking conventional pipe threads without the Dryseal feature, the gages are different with respect to truncation of threads, the crests of the threads at the minor diameter of the ring gages and the major diameter of the plug gages being truncated to a greater extent to clear the increased truncation of the product thread. Another distinction is that the Dryseal ( $L_2$ ) ring is counterbored larger than the thread diameter at the small end, a distance equal to the ( $L_1$ ) thread length minus one pitch. Conventional rings and plugs, however, may be converted to Dryseal by grinding the crests to conform with the width of flats specified for Dryseal gages, and grinding a counterbore in the ( $L_2$ ) ring gage.

The gages are turned or serewed handtight into or onto the threaded product, the position of the gage notch in relation to the product reference point being noted to determine whether the standoff exceeds the allowable tolerance. Allowance must be made for excessive chamfer at the small

**TABLE VIII.11.—Position method of gaging Dryseal pipe threads with basic-notch gages**

| Thread to be gaged                | Gaged with—                                                                                                                 |                                 | Gaging applicable to— | Threads are within the allowable tolerance when the product reference point is flush with the gage reference point within the following tolerances: |                        |
|-----------------------------------|-----------------------------------------------------------------------------------------------------------------------------|---------------------------------|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| 1                                 | 2                                                                                                                           | 3                               | 4                     | 5                                                                                                                                                   | 6                      |
| Dryseal • NPTF, external          | NPTF (L <sub>1</sub> ) and NPTF (L <sub>2</sub> ) basic-notch Dryseal ring thread gages                                     | Table VIII.15                   | All sizes             | Plus (small) 1 turn                                                                                                                                 | Minus (large) 1 turn   |
| Dryseal • PTF-SAE SHORT, external |                                                                                                                             |                                 | All sizes             | Plus (small) 0 turn                                                                                                                                 | Minus (large) 1½ turns |
|                                   |                                                                                                                             |                                 |                       | Threads are within the allowable tolerance when the product reference point is flush with the gage notch within the following tolerances:           |                        |
| DRYSEAL • NPTF, internal          | NPTF (L <sub>1</sub> ) basic-notch Dryseal plug thread gage and NPTF (L <sub>2</sub> ) basic-notch Dryseal plug thread gage | Table VIII.16 and Table VIII.17 | All sizes             | Plus (large) 1 turn                                                                                                                                 | Minus (small) 1 turn   |
| DRYSEAL • PTF-SAE SHORT, internal |                                                                                                                             |                                 | All sizes             | Plus (large) 0 turn                                                                                                                                 | Minus (small) 1½ turns |
| DRYSEAL • NPSF, internal          | NPTF (L <sub>1</sub> ) basic-notch Dryseal plug thread gage                                                                 | Table VIII.16                   | All sizes             | Plus (large) 0 turn                                                                                                                                 | Minus (small) 1½ turns |
| DRYSEAL • NPSI, internal          |                                                                                                                             |                                 | All sizes             | Plus (large) 1 turn                                                                                                                                 | Minus (small) ½ turn   |

\* As a check on taper, the (L<sub>1</sub>) and (L<sub>2</sub>) ring thread gages shall gage the same within ½ turn.

† As a check on taper, the (L<sub>1</sub>) and (L<sub>2</sub>) plug gages shall gage the same with relation to their respective notches within ½ turn.

‡ As depth is gaged without regard to gage notches, any of the (L<sub>2</sub>) Dryseal plug thread gages may be used to check the full thread length of internal straight pipe threads.

end of the external threads and the large end of internal threads, the product reference point in the first instance being the beginning of the first thread on the chamfer, and in the second instance being the intersection of the pitch cone and the chamfer cone, i.e., approximately ½ pitch below the point of last scratch on chamfer cone (see fig. VIII.2).

See table VIII.11 for the gages to be used on the various types of Dryseal threads and for the gaging tolerances to be applied.

(b) *Limit method of gaging with step-limit gages.*—The limit method of gaging Dryseal pipe threads with step-limit plug thread and ring thread gages is a visual check of the position of the gages in relation to the product. Plug and ring gages with maximum and minimum limit notches are provided for the different thread types. The location of the limit notches on the ⅜ and ¼ in. plugs eliminates the necessity for gaging correction.

**TABLE VIII.12.—Limit method of gaging Dryseal pipe threads with step-limit gages**

| Thread to be gaged                | Gaged with:                                                                                                                               |                                | Remarks                                                                                                         |
|-----------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|-----------------------------------------------------------------------------------------------------------------|
| 1                                 | 2                                                                                                                                         | 3                              | 4                                                                                                               |
| DRYSEAL • NPTF, external          | NPTF (L <sub>1</sub> ) step-limit Dryseal ring thread gage and NPTF (L <sub>2</sub> ) step-limit Dryseal ring thread gage                 | Table VIII.18<br>Table VIII.19 | Threads are within the allowable tolerance when the product reference point is on or between the limit notches. |
| DRYSEAL • PTF-SAE SHORT, external | PTF-SAE (L <sub>1</sub> Short) step-limit Dryseal ring thread gage and PTF-SAE (L <sub>2</sub> Short) step-limit Dryseal ring thread gage | Table VIII.22<br>Table VIII.23 |                                                                                                                 |
| DRYSEAL • NPTF, internal          | NPTF (L <sub>1</sub> ) step-limit Dryseal plug thread gage and NPTF (L <sub>2</sub> ) step-limit Dryseal plug thread gage                 | Table VIII.20<br>Table VIII.21 |                                                                                                                 |
| DRYSEAL • PTF-SAE SHORT, internal | PTF-SAE (L <sub>1</sub> Short) step-limit Dryseal plug thread gage and PTF-SAE (L <sub>2</sub> Short) step-limit Dryseal plug thread gage | Table VIII.24<br>Table VIII.25 |                                                                                                                 |
| DRYSEAL • NPSF, internal          | NPSF (L <sub>1</sub> Short) step-limit Dryseal plug thread gage                                                                           | Table VIII.24                  |                                                                                                                 |
| DRYSEAL • NPSI, internal          | NPSI (L <sub>1</sub> ) step-limit Dryseal plug thread gage                                                                                | Table VIII.26                  |                                                                                                                 |

\* As a check on taper, the gages shall gage the same with relation to their respective notches within ½ turn.

† As depth is gaged without regard to limit notches, any of the (L<sub>2</sub>) Dryseal plug thread gages may be used to check the full thread length of internal straight pipe threads.

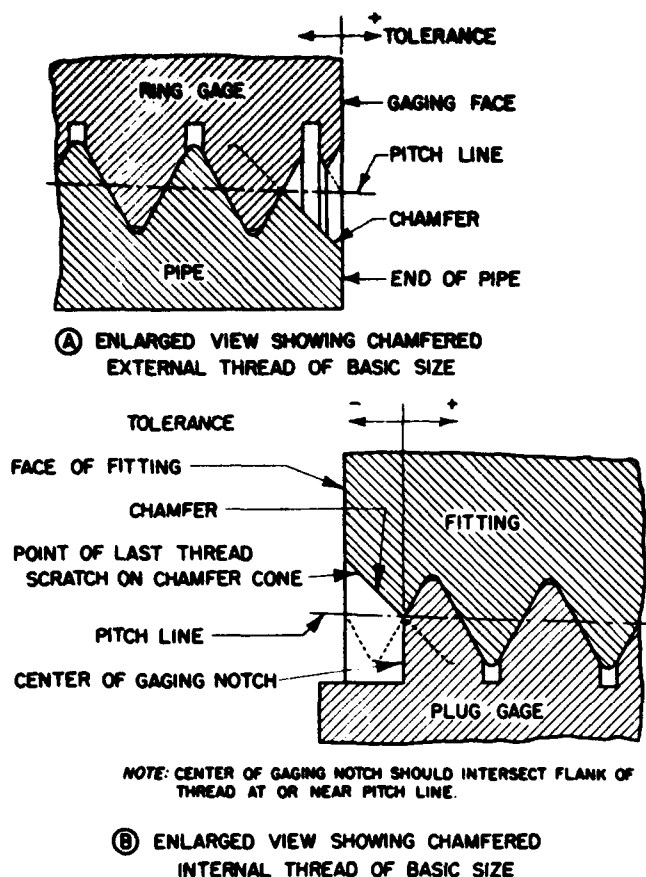


FIGURE VIII.2.—Gaging of chamfered threads (see pars. 3(a) and 3(b), pp. 27 and 28).

NOTE—The chamfer illustrated is at 45° angle and is  $\frac{1}{2}$  pitch in depth. However, these details are not requirements and are given only for information on the illustration shown. The chamfered portion of thread, and the full chamfer cone, are indicated by dotted lines.

The gages are turned or screwed handtight into or onto the threaded product, the position of the product reference point in relation to the limit notches on the gage being noted. Allowance must be made for excessive chamfer at the small end of external threads and the large end of internal threads, the product reference point in the first instance being the beginning of the first thread on the chamfer, and in the second instance being the intersection of the pitch diameter cone and the chamfer cone, i.e., approximately  $\frac{1}{2}$  pitch\* measured axially, from the point of last scratch on chamfer cone\* toward the opposite end of the fitting.

See table VIII.12 for the gages to be used on the various types of Dryseal threads and for the gaging tolerances to be applied.

(c) *Turns-engagement method of gaging with basic-notch or step-limit gages.*—The turns-engagement method of gaging threaded products with

plug thread and ring thread gages is a tactile check of the position of the gages in relation to the product. In checking by this method, either the basic-notch or the step-limit gages may be used. The gages are turned or screwed into or onto the threaded product and the turns to remove the gages are counted. This method compensates for gage chamfer and eliminates the variable of product chamfer.

The basic turns engagement of the ( $L_1$ ) ring thread gages (tables VIII.15, VIII.18, and VIII.22) with Dryseal external taper pipe threads is the product of the ( $L_1$ ) thread length of the ring gage used and the threads per inch, minus one turn to compensate for chamfer of the external threads and chamfer of the ring gages. Values for basic turns engagement are shown in table VIII.13.

The basic turns engagement of the ( $L_2$ ) ring thread gages (tables VIII.15, VIII.19, and VIII.23) with Dryseal external taper pipe threads is the product of the ( $L_2$ ) thread length and the threads per inch, minus  $1\frac{1}{4}$  turns to compensate for chamfer of the external threads and the chamfer and taper of the ring gages. Values for basic turns engagement are shown in table VIII.13.

The basic turns engagement of the ( $L_1$ ) plug thread gages (tables VIII.16, VIII.20, VIII.24, and VIII.26) with Dryseal internal pipe threads is the product of the ( $L_1$ ) thread length (table VIII.4) and the threads per inch, minus  $\frac{1}{2}$  turn to compensate for chamfer on plug gages. Values for basic turns engagement are shown in table VIII.13.

The basic turns engagement of the ( $L_3$ ) plug thread gages (tables VIII.17, VIII.21, and VIII.25) with Dryseal internal pipe threads is the ( $L_1$ ) thread length (table VIII.4) plus three threads, multiplied by the threads per inch, minus  $\frac{3}{4}$  turn to compensate for chamfer and taper on plug gages. Values for basic turns engagement are shown in table VIII.13.

See table VIII.14 for the gages to be used on the various types of Dryseal threads and for the gaging tolerances to be applied.

4. **MARKING OF GAGES.**—Gages shall be marked as shown in the following examples:

Basic-notch  $\frac{1}{8}$ —27 DRYSEAL NPTF( $L_1$ )  
 Step-limit 1—11½ DRYSEAL PTF-SAE  
 SHORT ( $L_1$  Short)

Tables VIII.15, VIII.16, and VIII.17 cover basic-notch gages. Tables VIII.18 through VIII.26 cover step-limit gages. The last part of the gage marking is specified on tables VIII.15 through VIII.26.

TABLE VIII.13.—Basic turns engagement

| Size                              | Basic turns engagement of gages |                                         |                                                                       |                                                                                |                                                                       |
|-----------------------------------|---------------------------------|-----------------------------------------|-----------------------------------------------------------------------|--------------------------------------------------------------------------------|-----------------------------------------------------------------------|
|                                   | <i>L</i> <sub>1</sub> Rings     |                                         | All <i>L</i> <sub>1</sub> rings, tables VIII.15, VIII.19, and VIII.23 | All <i>L</i> <sub>1</sub> plugs, tables VIII.16, VIII.20, VIII.24, and VIII.26 | All <i>L</i> <sub>2</sub> plugs, tables VIII.17, VIII.21, and VIII.25 |
|                                   | Basic-notch, table VIII.15      | Step-limit, tables VIII.18, and VIII.22 |                                                                       |                                                                                |                                                                       |
| $\frac{1}{16}$ —27                | 3.32                            | 3.32                                    | 5.80                                                                  | 3.82                                                                           | 6.57                                                                  |
| $\frac{1}{8}$ —27                 | 3.36                            | 3.36                                    | 5.87                                                                  | 3.86                                                                           | 6.61                                                                  |
| $\frac{1}{4}$ —18                 | 3.10                            | 3.10                                    | 5.98                                                                  | 3.60                                                                           | 6.35                                                                  |
| $\frac{3}{8}$ —18                 | 3.32                            | 3.32                                    | 6.09                                                                  | 3.82                                                                           | 6.57                                                                  |
| $\frac{1}{2}$ —14                 | 3.48                            | 3.48                                    | 6.22                                                                  | 3.98                                                                           | 6.73                                                                  |
| $\frac{3}{4}$ —14                 | 3.75                            | 3.75                                    | 6.39                                                                  | 4.25                                                                           | 7.00                                                                  |
| 1—11 $\frac{1}{2}$                | 3.60                            | 3.60                                    | 6.60                                                                  | 4.10                                                                           | 6.85                                                                  |
| 1 $\frac{1}{4}$ —11 $\frac{1}{2}$ | 3.83                            | 3.83                                    | 6.88                                                                  | 4.33                                                                           | 7.08                                                                  |
| 1 $\frac{1}{2}$ —11 $\frac{1}{2}$ | 3.83                            | 3.83                                    | 7.07                                                                  | 4.33                                                                           | 7.08                                                                  |
| 2—11 $\frac{1}{2}$                | 4.01                            | 4.01                                    | 7.45                                                                  | 4.51                                                                           | 7.26                                                                  |
| 2 $\frac{1}{2}$ —8                | 4.46                            | 4.46                                    | 7.85                                                                  | 4.96                                                                           | 7.71                                                                  |
| 3—8                               | 5.13                            | 5.13                                    | 8.35                                                                  | 5.63                                                                           | 8.38                                                                  |

TABLE VIII.14.—Turns-engagement method of gaging Dry-seal pipe threads with basic-notch or step-limit gages

| Thread to be gaged                         | Gaged with:                                                                                           |                                                                           | Nominal * turns engagement equals:        | Tolerance:          |                                  |
|--------------------------------------------|-------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------|-------------------------------------------|---------------------|----------------------------------|
| 1                                          | 2                                                                                                     | 3                                                                         | 4                                         | 5                   | 6                                |
| DRYSEAL *<br>NPTF,<br>external             | Any combination of ( <i>L</i> <sub>1</sub> ) and ( <i>L</i> <sub>2</sub> ) Dry-seal ring thread gages | Tables VIII.15<br>VIII.18<br>VIII.19<br>VIII.22<br>VIII.23                | Basic turns engagement                    | Plus (small) 1 turn | Minus (large) 1 turn             |
| DRYSEAL *<br>PTF-SAE<br>SHORT,<br>external |                                                                                                       |                                                                           | One turn less than basic turns engagement | Plus (small) 1 turn | Minus (large) $\frac{1}{2}$ turn |
| DRYSEAL *<br>NPTF,<br>internal             | Any combination of ( <i>L</i> <sub>1</sub> ) and ( <i>L</i> <sub>2</sub> ) Dry-seal plug thread gages | VIII.16<br>VIII.17<br>VIII.20<br>VIII.21<br>VIII.24<br>VIII.25<br>VIII.26 | Basic turns engagement                    | Plus (large) 1 turn | Minus (small) 1 turn             |
| DRYSEAL *<br>PTF-SAE<br>SHORT,<br>internal |                                                                                                       |                                                                           | One turn less than basic turns engagement | Plus (large) 1 turn | Minus (small) $\frac{1}{2}$ turn |
| DRYSEAL *<br>NPSF,<br>internal             | Any of the ( <i>L</i> <sub>1</sub> ) Dry-seal plug thread gages                                       | VIII.16<br>VIII.20<br>VIII.24<br>VIII.26                                  | One turn less than basic turns engagement | Plus (large) 1 turn | Minus (small) $\frac{1}{2}$ turn |
| DRYSEAL *<br>NPSI,<br>internal             |                                                                                                       |                                                                           | Basic turns engagement                    | Plus (large) 1 turn | Minus (small) $\frac{1}{2}$ turn |

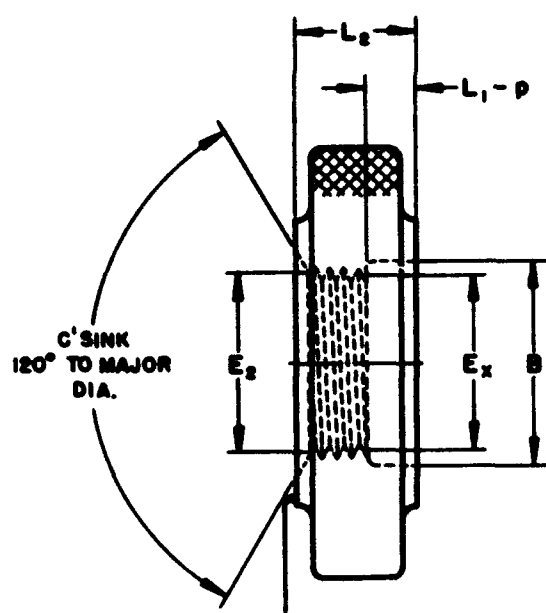
\* See table VIII.13 for basic turns engagement.

\* As a check on taper, the difference in turns engagement of the (*L*<sub>1</sub>) and (*L*<sub>2</sub>) Dryseal ring thread gages shall be within  $\frac{1}{2}$  turn of the difference between the basic turns engagement of the ring thread gages.

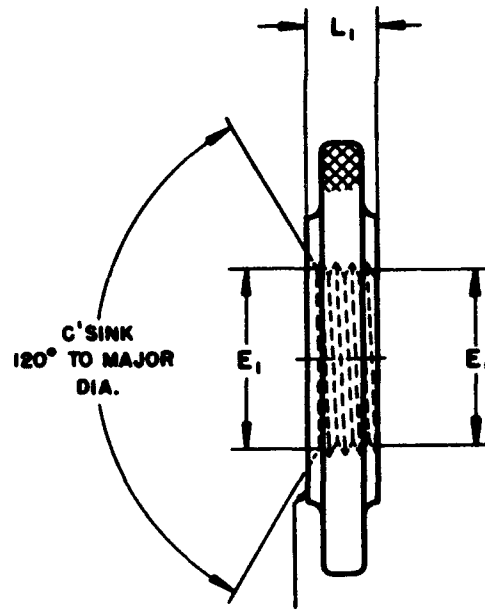
\* As a check on taper, the difference in turns engagement of the (*L*<sub>1</sub>) and (*L*<sub>2</sub>) Dryseal plug thread gages shall not be less than  $2\frac{1}{4}$  turns nor more than  $3\frac{1}{4}$  turns.

\* As depth is gaged without regard to limit notches, any of the (*L*<sub>2</sub>) Dry-seal plug thread gages may be used to check the full thread length of internal straight pipe threads.

TABLE VIII.15.—Basic dimensions of Dryseal American Standard taper pipe thread ( $L_1$  and  $L_2$ ) basic-notch ring gages, NPTF



IN ADDITION TO REGULAR MARKINGS, MARK NPTF( $L_2$ ) ON THIS SIDE OF GAGE.



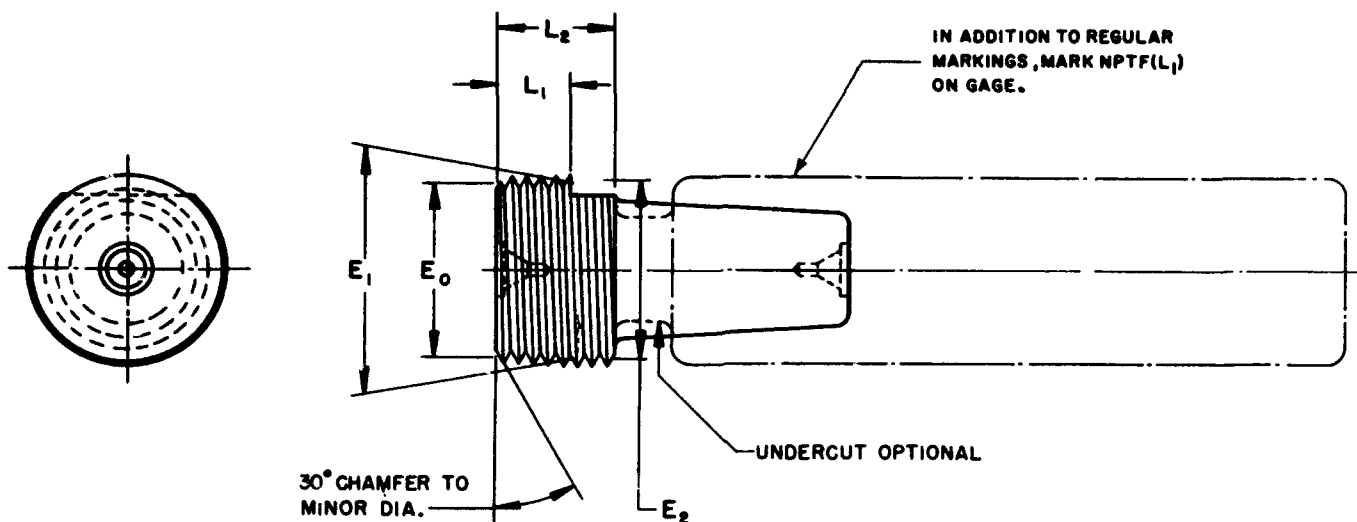
IN ADDITION TO REGULAR MARKINGS, MARK NPTF( $L_1$ ) ON THIS SIDE OF GAGE.

| Size                              | (L <sub>2</sub> ) basic-notch full-ring gages |                       |                             |                                     |                             |                       |                             | (L <sub>1</sub> ) basic-notch thin-ring gages |                       |                             |                       |                             |
|-----------------------------------|-----------------------------------------------|-----------------------|-----------------------------|-------------------------------------|-----------------------------|-----------------------|-----------------------------|-----------------------------------------------|-----------------------|-----------------------------|-----------------------|-----------------------------|
|                                   | $L_1$                                         | Pitch diameter, $E_2$ | Minor diameter at large end | Pitch diameter at $L_1 - p$ , $E_x$ | Minor diameter at $L_1 - p$ | $L_1 - p$             | C'bore diameter, $B$        | $L_1$                                         | Pitch diameter, $E_1$ | Minor diameter at large end | Pitch diameter, $E_0$ | Minor diameter at small end |
| 1                                 | 2                                             | 3                     | 4                           | 5                                   | 6                           | 7                     | 8                           | 9                                             | 10                    | 11                          | 12                    | 13                          |
| $\frac{1}{16}$ —27                | <i>in.</i><br>0.26112                         | <i>in.</i><br>0.26750 | <i>in.</i><br>0.27024       | <i>in.</i><br>0.27886               | <i>in.</i><br>0.26100       | <i>in.</i><br>0.12286 | <i>in.</i><br>$\frac{3}{4}$ | <i>in.</i><br>0.1600                          | <i>in.</i><br>0.26118 | <i>in.</i><br>0.26392       | <i>in.</i><br>0.27118 | <i>in.</i><br>0.26902       |
| $\frac{1}{8}$ —27                 | .26985                                        | .28000                | .28274                      | .27129                              | .25408                      | .12446                | $\frac{1}{2}$               | .1615                                         | .27360                | .25634                      | .26351                | .24626                      |
| $\frac{1}{4}$ —18                 | .40178                                        | .50280                | .47661                      | .48816                              | .46227                      | .17234                | $1\frac{1}{2}$              | .2278                                         | .49163                | .46574                      | .47739                | .45180                      |
| $\frac{3}{8}$ —18                 | .40778                                        | .63750                | .61161                      | .62354                              | .59766                      | .18444                | $2\frac{1}{2}$              | .2400                                         | .62701                | .60112                      | .61201                | .58612                      |
| $\frac{1}{2}$ —14                 | .53371                                        | .79179                | .75850                      | .77306                              | .74057                      | .24857                | $\frac{3}{4}$               | .3200                                         | .77843                | .74514                      | .75843                | .72614                      |
| $\frac{3}{4}$ —14                 | .54571                                        | 1.00179               | .96850                      | .98440                              | .95111                      | .26757                | $1\frac{1}{2}$              | .3300                                         | .98887                | .95558                      | .96768                | .93499                      |
| 1—11 $\frac{1}{2}$                | .66278                                        | 1.25630               | 1.21577                     | 1.23320                             | 1.19267                     | .31304                | $1\frac{1}{2}$              | .4000                                         | 1.23863               | 1.19810                     | 1.21363               | 1.17810                     |
| 1 $\frac{1}{4}$ —11 $\frac{1}{2}$ | .70678                                        | 1.60130               | 1.56077                     | 1.57794                             | 1.53741                     | .33304                | $1\frac{1}{2}$              | .4200                                         | 1.56338               | 1.54285                     | 1.55713               | 1.51000                     |
| 1 $\frac{1}{2}$ —11 $\frac{1}{2}$ | .72348                                        | 1.84130               | 1.80077                     | 1.81690                             | 1.77637                     | .33304                | $1\frac{1}{2}$              | .4200                                         | 1.82234               | 1.78181                     | 1.79609               | 1.75556                     |
| 2—11 $\frac{1}{2}$                | .75632                                        | 2.31630               | 2.27577                     | 2.29084                             | 2.25031                     | .34004                | 2 $\frac{1}{2}$             | .4300                                         | 2.29627               | 2.25574                     | 2.26902               | 2.22849                     |
| 2 $\frac{1}{2}$ —8                | 1.13750                                       | 2.79062               | 2.73237                     | 2.75434                             | 2.69509                     | .55700                | 2 $\frac{1}{2}$             | .6820                                         | 2.78216               | 2.70391                     | 2.71953               | 2.66128                     |
| 3—8                               | 1.20000                                       | 3.41582               | 3.35737                     | 3.38068                             | 3.32343                     | .64100                | 3 $\frac{1}{2}$             | .7000                                         | 3.38850               | 3.33025                     | 3.34062               | 3.28237                     |

• Minor diameter is based on crest minimum truncation of 0.20p.

\* This dimension has been revised. For the superseded dimension see subsection 9, appendix 7, p. 109.

TABLE VIII.16.—Basic dimensions of Dryseal American Standard taper pipe thread ( $L_1$ ) basic-notch plug gages, NPTF

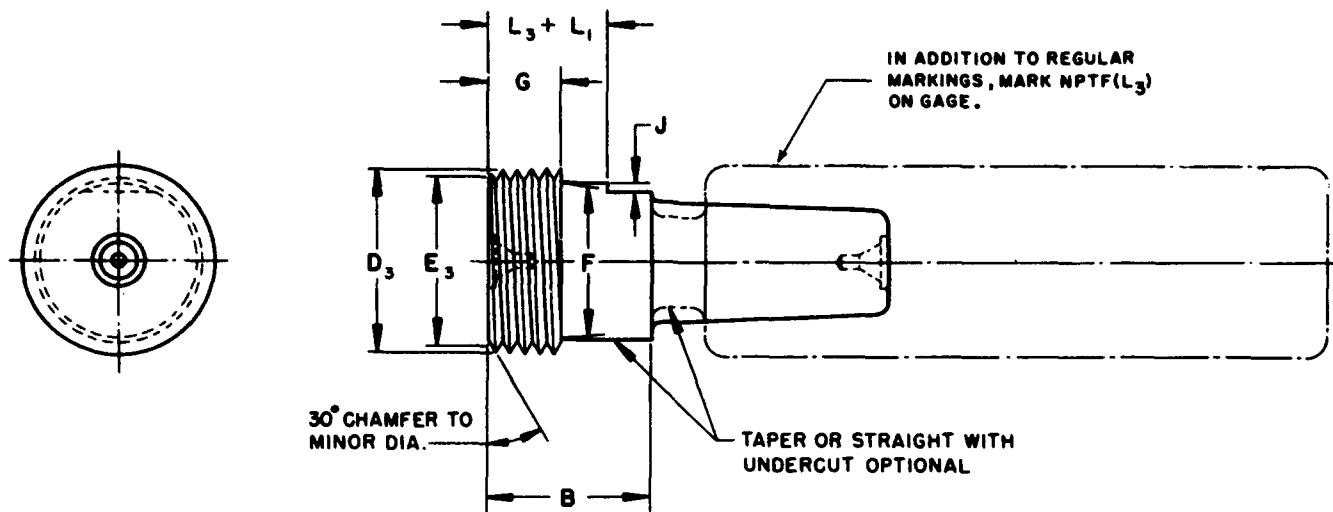


| Size                              | $L_1$                | $L_2$                 | Small end             |                             | Gaging notch          |                             | Large end             |                             |
|-----------------------------------|----------------------|-----------------------|-----------------------|-----------------------------|-----------------------|-----------------------------|-----------------------|-----------------------------|
|                                   |                      |                       | Pitch diameter, $E_0$ | Major diameter <sup>a</sup> | Pitch diameter, $E_1$ | Major diameter <sup>a</sup> | Pitch diameter, $E_2$ | Major diameter <sup>a</sup> |
| 1                                 | 2                    | 3                     | 4                     | 5                           | 6                     | 7                           | 8                     | 9                           |
| $\frac{1}{16}$ —27                | <i>in.</i><br>0.1600 | <i>in.</i><br>0.26113 | <i>in.</i><br>0.27118 | <i>in.</i><br>0.28844       | <i>in.</i><br>0.28118 | <i>in.</i><br>0.28844       | <i>in.</i><br>0.28750 | <i>in.</i><br>0.30476       |
| $\frac{1}{8}$ —27                 | <sup>b</sup> .1615   | .26385                | .36351                | .38077                      | <sup>b</sup> .37360   | <sup>b</sup> .39086         | .38000                | .39726                      |
| $\frac{1}{4}$ —18                 | <sup>b</sup> .2278   | .40178                | .47739                | .50328                      | <sup>b</sup> .49163   | <sup>b</sup> .51752         | .50250                | .52839                      |
| $\frac{3}{8}$ —18                 | .2400                | .40778                | .61201                | .63790                      | .62701                | .65290                      | .63750                | .66339                      |
| $\frac{1}{2}$ —14                 | .3200                | .53371                | .75843                | .79170                      | .77843                | .81170                      | .79179                | .82506                      |
| $\frac{3}{4}$ —14                 | .3390                | .54571                | .96768                | 1.00095                     | .98887                | 1.02214                     | 1.00179               | 1.03506                     |
| 1—11 $\frac{1}{2}$                | .4000                | .68278                | 1.21363               | 1.25416                     | 1.23863               | 1.27916                     | 1.25630               | 1.29683                     |
| 1 $\frac{1}{4}$ —11 $\frac{1}{2}$ | .4200                | .70678                | 1.55713               | 1.59766                     | 1.58338               | 1.62391                     | 1.60130               | 1.64183                     |
| 1 $\frac{1}{2}$ —11 $\frac{1}{2}$ | .4200                | .72348                | 1.79609               | 1.83662                     | 1.82234               | 1.86287                     | 1.84130               | 1.88183                     |
| 2—11 $\frac{1}{2}$                | .4360                | .75652                | 2.26902               | 2.30955                     | 2.29627               | 2.33680                     | 2.31630               | 2.35683                     |
| 2 $\frac{1}{2}$ —8                | .6820                | 1.13750               | 2.71953               | 2.77778                     | 2.76216               | 2.82041                     | 2.79062               | 2.84887                     |
| 3—8                               | .7660                | 1.20000               | 3.34062               | 3.39887                     | 3.38850               | 3.44675                     | 3.41562               | 3.47387                     |

<sup>a</sup> Major diameter is based upon crest minimum truncation of 0.20p.

<sup>b</sup> This dimension has been revised. For the superseded dimension see subsection 9, appendix 7, p. 109.

TABLE VIII.17.—Basic dimensions of Dryscal American Standard taper pipe thread ( $L_3$ ) basic-notch plug gages, NPTF

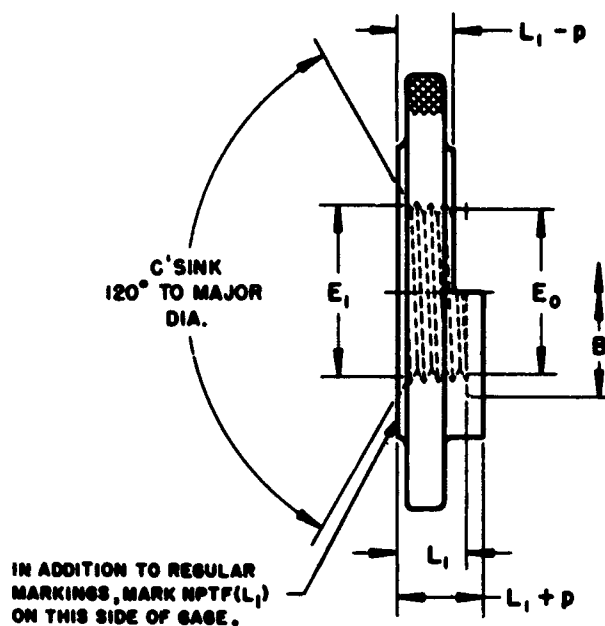


| Size                              | Small end                  |                             | Relief diameter<br>( $E_3 + 0.0625 \times 4p$ —<br>sharp-V thd<br>hgt—0.020 to 0.025<br>below sharp root);<br>$F + 0.005$ , —0.000 | Four threads,<br>$G$ , ( $L_3 + p$ ) | $L_1 + 3$ threads,<br>( $L_1 + L_3$ )* | Blank length,<br>$B$ | Notch depth,<br>$J + 0.005$ ,<br>—0.000 |
|-----------------------------------|----------------------------|-----------------------------|------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|----------------------------------------|----------------------|-----------------------------------------|
|                                   | Pitch diam-<br>eter, $E_3$ | Major* diam-<br>eter, $D_3$ |                                                                                                                                    |                                      |                                        |                      |                                         |
| 1                                 | 2                          | 3                           | 4                                                                                                                                  | 5                                    | 6                                      | 7                    | 8                                       |
|                                   | in.                        | in.                         | in.                                                                                                                                | in.                                  | in.                                    | in.                  | in.                                     |
| $\frac{1}{16}$ —27                | 0.2642                     | 0.2815                      | 0.216                                                                                                                              | 0.1482                               | 0.2711                                 | $\frac{3}{8}$        | 0.030                                   |
| $\frac{1}{8}$ —27                 | .3558                      | .3738                       | .309                                                                                                                               | .1482                                | .2726                                  | $\frac{13}{32}$      | .030                                    |
| $\frac{1}{4}$ —18                 | .4670                      | .4928                       | .409                                                                                                                               | .2222                                | .3945                                  | $\frac{1}{2}$        | .030                                    |
| $\frac{3}{8}$ —18                 | .6016                      | .6275                       | .542                                                                                                                               | .2222                                | .4067                                  | $\frac{9}{16}$       | .030                                    |
| $\frac{1}{2}$ —14                 | .7451                      | .7783                       | .676                                                                                                                               | .2857                                | .5343                                  | $\frac{11}{16}$      | .040                                    |
| $\frac{3}{4}$ —14                 | .9543                      | .9876                       | .886                                                                                                                               | .2857                                | .5533                                  | $\frac{23}{32}$      | .040                                    |
| 1—11 $\frac{1}{2}$                | 1.1973                     | 1.2379                      | 1.118                                                                                                                              | .3478                                | .6609                                  | $\frac{7}{8}$        | .050                                    |
| 1 $\frac{1}{4}$ —11 $\frac{1}{2}$ | 1.5408                     | 1.5814                      | 1.462                                                                                                                              | .3478                                | .6809                                  | $\frac{7}{8}$        | .050                                    |
| 1 $\frac{1}{2}$ —11 $\frac{1}{2}$ | 1.7798                     | 1.8203                      | 1.701                                                                                                                              | .3478                                | .6809                                  | $\frac{7}{8}$        | .050                                    |
| 2—11 $\frac{1}{2}$                | 2.2527                     | 2.2932                      | 2.174                                                                                                                              | .3478                                | .6969                                  | $\frac{7}{8}$        | .050                                    |
| 2 $\frac{1}{2}$ —8                | 2.6961                     | 2.7543                      | 2.590                                                                                                                              | .5000                                | 1.0570                                 | 1 $\frac{1}{2}$      | .050                                    |
| 3—8                               | 3.3172                     | 3.3754                      | 3.214                                                                                                                              | .5000                                | 1.1410                                 | 1 $\frac{1}{2}$      | .050                                    |

\* Major diameter is based upon crest minimum truncation of 0.20p.

\* This dimension has been revised. For the superseded dimension see subsection 9, appendix 7, p. 109.

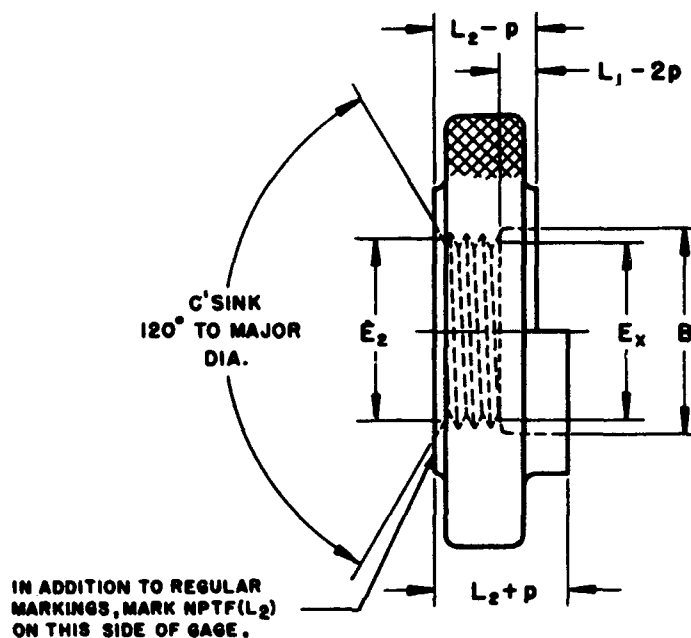
TABLE VIII.18.—Basic dimensions of Dryseal American Standard taper pipe thread ( $L_1$ ) step-limit thin ring gages, NPTF



| Size                              | ( $L_1$ ) step-limit thin-ring gages |                                           |                                           |                       |                               |                                           |                                      |                       |
|-----------------------------------|--------------------------------------|-------------------------------------------|-------------------------------------------|-----------------------|-------------------------------|-------------------------------------------|--------------------------------------|-----------------------|
|                                   | $L_1$                                | Max pitch diameter gaging step, $L_1 - p$ | Min pitch diameter gaging step, $L_1 + p$ | Pitch diameter, $E_1$ | Minor diameter • at large end | Pitch diameter at small end c'bore, $E_0$ | Minor diameter • at small end c'bore | C'bore diameter, $B$  |
| 1                                 | 2                                    | 3                                         | 4                                         | 5                     | 6                             | 7                                         | 8                                    | 9                     |
| $\frac{1}{16}$ —27                | in.<br>0.1600                        | in.<br>0.12296                            | in.<br>0.19704                            | in.<br>0.28118        | in.<br>0.26392                | in.<br>0.27118                            | in.<br>0.25892                       | in.<br>$\frac{3}{16}$ |
| $\frac{1}{8}$ —27                 | .1615                                | .12446                                    | .19854                                    | .27360                | .25634                        | .26351                                    | .24625                               | $\frac{13}{32}$       |
| $\frac{1}{4}$ —18                 | .2278                                | .17224                                    | .28336                                    | .49163                | .46574                        | .47739                                    | .45150                               | $\frac{19}{32}$       |
| $\frac{3}{8}$ —18                 | .2400                                | .18444                                    | .29556                                    | .62701                | .60112                        | .61201                                    | .58612                               | $\frac{23}{32}$       |
| $\frac{1}{2}$ —14                 | .3200                                | .24857                                    | .39143                                    | .77843                | .74514                        | .75843                                    | .72514                               | $\frac{7}{8}$         |
| $\frac{3}{4}$ —14                 | .3390                                | .26757                                    | .41043                                    | .98887                | .95556                        | .96768                                    | .93439                               | $1\frac{1}{32}$       |
| 1—11 $\frac{1}{2}$                | .4000                                | .31304                                    | .48696                                    | 1.23863               | 1.19810                       | 1.21363                                   | 1.17810                              | $1\frac{11}{32}$      |
| 1 $\frac{1}{4}$ —11 $\frac{1}{2}$ | .4200                                | .33304                                    | .50696                                    | 1.58338               | 1.54285                       | 1.55713                                   | 1.51660                              | $1\frac{11}{16}$      |
| 1 $\frac{3}{4}$ —11 $\frac{1}{2}$ | .4200                                | .33304                                    | .50696                                    | 1.82234               | 1.78181                       | 1.79609                                   | 1.75556                              | $1\frac{13}{16}$      |
| 2—11 $\frac{1}{2}$                | .4360                                | .34904                                    | .52296                                    | 2.29627               | 2.25574                       | 2.26902                                   | 2.22849                              | $2\frac{1}{2}$        |
| 2 $\frac{1}{4}$ —8                | .6820                                | .55700                                    | .80700                                    | 2.78216               | 2.70391                       | 2.71953                                   | 2.66128                              | $2\frac{13}{16}$      |
| 3—8                               | .7660                                | .64100                                    | .89100                                    | 3.39850               | 3.33025                       | 3.34062                                   | 3.28237                              | $3\frac{9}{16}$       |

• Minor diameter is based on crest minimum truncation of  $0.20p$ .

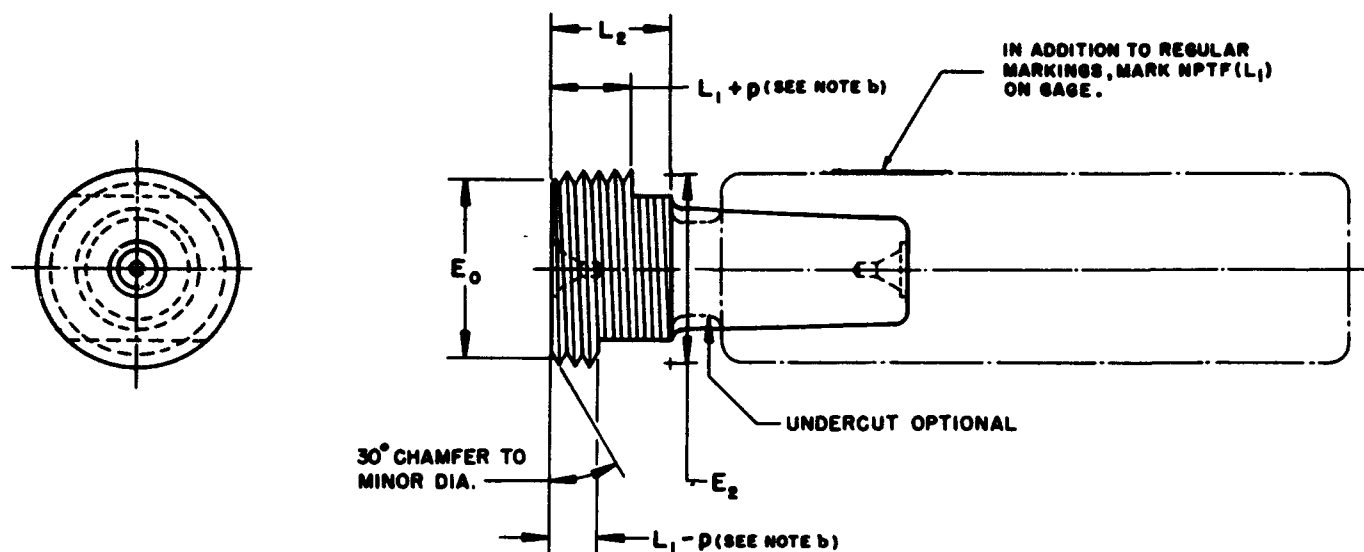
TABLE VIII.19.—Basic dimensions of Dryseal American Standard taper pipe thread ( $L_2$ ) step-limit full-ring gages, NPTF



| Size         | (L <sub>2</sub> ) step-limit full-ring gages |                                                   |                                                   |                                |                               |                                                                          |                                      |                    |                    |
|--------------|----------------------------------------------|---------------------------------------------------|---------------------------------------------------|--------------------------------|-------------------------------|--------------------------------------------------------------------------|--------------------------------------|--------------------|--------------------|
|              | L <sub>2</sub>                               | Max pitch diameter gaging step, L <sub>1</sub> -p | Min pitch diameter gaging step, L <sub>2</sub> +p | Pitch diameter, E <sub>2</sub> | Minor diameter • at large end | Pitch diameter at L <sub>1</sub> from min PD gaging step, E <sub>2</sub> | Minor diameter • at small end c'bore | L <sub>1</sub> -2p | C'bore diameter, B |
| 1            | 2                                            | 3                                                 | 4                                                 | 5                              | 6                             | 7                                                                        | 8                                    | 9                  | 10                 |
|              | in.                                          | in.                                               | in.                                               | in.                            | in.                           | in.                                                                      | in.                                  | in.                | in.                |
| 1/16-27      | 0.26113                                      | 0.22409                                           | 0.29817                                           | 0.28750                        | 0.27024                       | 0.27886                                                                  | 0.26160                              | 0.08592            | 3/16               |
| 1/8-27       | .26385                                       | .22681                                            | .30069                                            | .38000                         | .36274                        | .37129                                                                   | .35403                               | .08742             | 15/32              |
| 1/4-18       | .40178                                       | .34622                                            | .45734                                            | .50250                         | .47661                        | .48816                                                                   | .46227                               | .11668             | 19/32              |
| 3/8-18       | .40778                                       | .35222                                            | .46334                                            | .63750                         | .61161                        | .62354                                                                   | .59765                               | .12888             | 23/32              |
| 1/2-14       | .53371                                       | .46228                                            | .60514                                            | .79179                         | .75850                        | .77396                                                                   | .74067                               | .17714             | 7/8                |
| 3/4-14       | .54571                                       | .47428                                            | .61714                                            | 1.00179                        | .96850                        | .98440                                                                   | .95111                               | .19614             | 1 3/32             |
| 1-11 1/2     | .68279                                       | .59582                                            | .76974                                            | 1.25630                        | 1.21577                       | 1.23320                                                                  | 1.19267                              | .22608             | 1 11/32            |
| 1 1/4-11 1/2 | .70678                                       | .61982                                            | .79374                                            | 1.60130                        | 1.56077                       | 1.57794                                                                  | 1.53741                              | .24608             | 1 11/16            |
| 1 1/2-11 1/2 | .72348                                       | .63652                                            | .81044                                            | 1.84130                        | 1.80077                       | 1.81690                                                                  | 1.77637                              | .24608             | 1 5/8              |
| 2-11 1/2     | .75652                                       | .66956                                            | .84348                                            | 2.31630                        | 2.27577                       | 2.29084                                                                  | 2.25031                              | .26208             | 2 1/2              |
| 2 1/2-8      | 1.13750                                      | 1.01250                                           | 1.26250                                           | 2.79062                        | 2.73237                       | 2.75434                                                                  | 2.69609                              | .43200             | 2 13/16            |
| 3-8          | 1.20000                                      | 1.07500                                           | 1.32500                                           | 3.41562                        | 3.35737                       | 3.38068                                                                  | 3.32243                              | .51600             | 3 9/16             |

• Minor diameter is based on crest minimum truncation of 0.20p.

TABLE VIII.20.—Basic dimensions of Dryseal American Standard taper pipe thread ( $L_1$ ) step-limit plug gages, NPTF

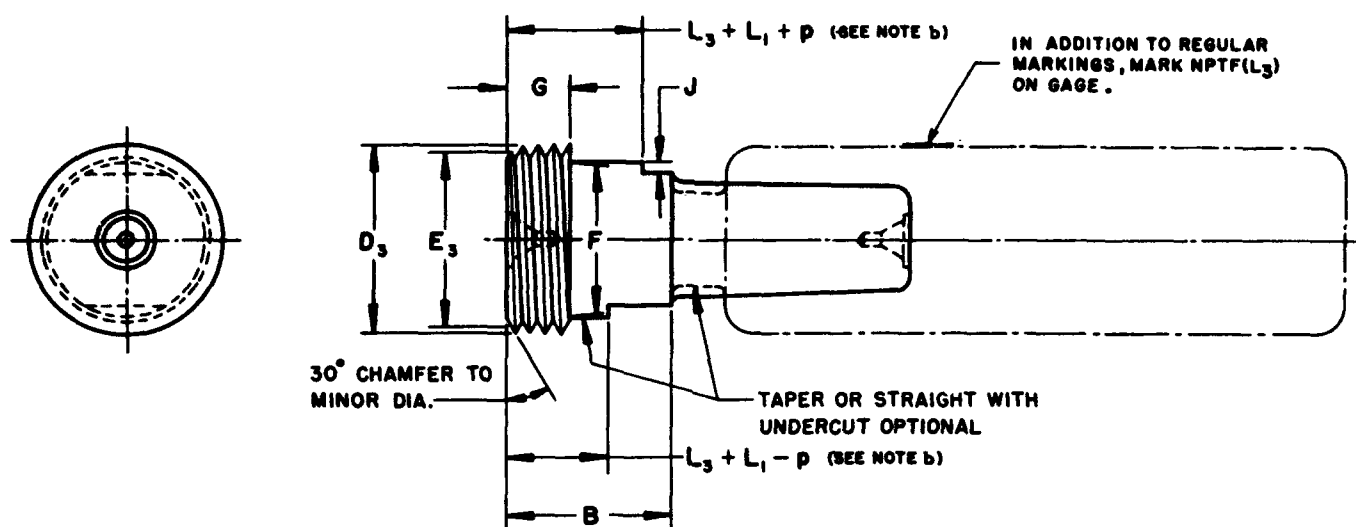


| Size               | $L_1$         | $L_2$          | Small end             |                  | Min PD gaging step |                | Max PD gaging step |                | Large end             |                  |
|--------------------|---------------|----------------|-----------------------|------------------|--------------------|----------------|--------------------|----------------|-----------------------|------------------|
|                    |               |                | Pitch diameter, $E_0$ | Major * diameter | $L_1 - p$          | Pitch diameter | $L_1 + p$          | Pitch diameter | Pitch diameter, $E_2$ | Major * diameter |
| 1                  | 2             | 3              | 4                     | 5                | 6                  | 7              | 8                  | 9              | 10                    | 11               |
| $\frac{1}{16}$ —27 | in.<br>0.1600 | in.<br>0.26113 | in.<br>0.27118        | in.<br>0.28844   | in.<br>0.12296     | in.<br>0.27887 | in.<br>0.19704     | in.<br>0.28350 | in.<br>0.28750        | in.<br>0.30476   |
| $\frac{1}{8}$ —27  | .1615         | .26385         | .36351                | .38077           | .12446             | .37129         | .19854             | .37592         | .38000                | .39726           |
| $\frac{1}{4}$ —18  | .2278         | .40178         | .47739                | .50328           | .17224             | .48816         | .28336             | .49510         | .50250                | .52839           |
| $\frac{3}{4}$ —18  | .2400         | .40778         | .61201                | .63790           | .18444             | .62354         | .29556             | .63048         | .63750                | .66339           |
| $\frac{1}{2}$ —14  | .3200         | .53371         | .75843                | .79172           | .24857             | .77397         | .39143             | .78289         | .79179                | .82508           |
| $\frac{3}{4}$ —14  | .3390         | .54571         | .96768                | 1.00097          | .26757             | .98441         | .41043             | .98333         | 1.00179               | 1.03508          |
| 1—11½              | .4000         | .68278         | 1.21363               | 1.25416          | .31304             | 1.23320        | .48696             | 1.24408        | 1.25630               | 1.29683          |
| 1½—11½             | .4200         | .70678         | 1.55713               | 1.59766          | .33304             | 1.57795        | .50696             | 1.58882        | 1.60130               | 1.64183          |
| 1½—11½             | .4200         | .72348         | 1.79609               | 1.83662          | .33304             | 1.81691        | .50696             | *1.82777       | 1.84130               | 1.88183          |
| 2—11½              | .4360         | .75652         | 2.26902               | 2.30955          | .34904             | 2.29084        | .52296             | 2.30170        | 2.31630               | 2.35683          |
| 2½—8               | .6820         | 1.13750        | 2.71953               | 2.77778          | .55700             | 2.75435        | .80700             | 2.76997        | 2.79062               | 2.84887          |
| 3—8                | .7640         | 1.20000        | 3.34062               | 3.39887          | .64100             | 3.38069        | .89100             | 3.39631        | 3.41562               | 3.47387          |

\* Major diameter is based upon crest minimum truncation of 0.20p.

\* Maximum and minimum pitch-diameter steps are gaging limits. Notch formulas on drawing apply to all sizes.

TABLE VIII.21.—Basic dimensions of Dryseal American Standard taper pipe thread ( $L_3$ ) step-limit plug gages, NPTF

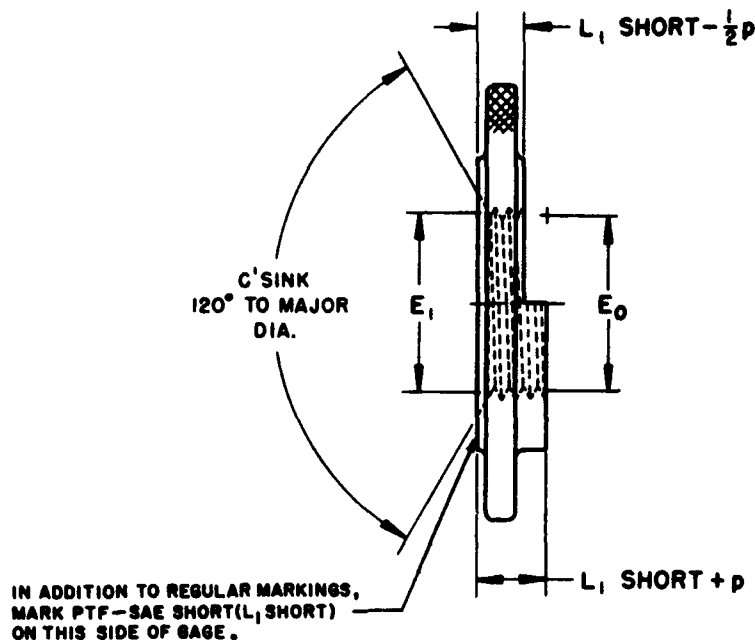


| Size              | Small end                |                            | Relief diameter<br>( $E_3 + 0.0625 \times 4p$ —<br>sharp-V thd hgt<br>—0.020 to 0.025<br>below sharp root);<br>$F + 0.005$ , —0.000 | Four<br>threads, $G$ ,<br>( $L_3 + p$ ) | Min pitch<br>diameter<br>gaging<br>step+3 thds,<br>( $L_3 + L_1 - p$ ) | Max pitch<br>diameter<br>gaging<br>step+3 thds,<br>( $L_3 + L_1 + p$ ) | Blank<br>length, $B$ | Notch<br>depth, $J$<br>$+0.005$ ,<br>—0.000 |
|-------------------|--------------------------|----------------------------|-------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|------------------------------------------------------------------------|------------------------------------------------------------------------|----------------------|---------------------------------------------|
|                   | Pitch<br>diameter, $E_3$ | Major *<br>diameter, $D_3$ |                                                                                                                                     |                                         |                                                                        |                                                                        |                      |                                             |
| 1                 | 2                        | 3                          | 4                                                                                                                                   | 5                                       | 6                                                                      | 7                                                                      | 8                    | 9                                           |
|                   | <i>in.</i>               | <i>in.</i>                 | <i>in.</i>                                                                                                                          | <i>in.</i>                              | <i>in.</i>                                                             | <i>in.</i>                                                             | <i>in.</i>           | <i>in.</i>                                  |
| $\frac{1}{8}$ —27 | 0.2642                   | 0.2815                     | 0.216                                                                                                                               | 0.1482                                  | 0.2341                                                                 | 0.3082                                                                 | $\frac{3}{8}$        | 0.030                                       |
| $\frac{1}{4}$ —27 | .3566                    | .3738                      | .309                                                                                                                                | .1482                                   | .2356                                                                  | .3097                                                                  | $\frac{13}{32}$      | .030                                        |
| $\frac{3}{4}$ —18 | .4670                    | .4928                      | .409                                                                                                                                | .2222                                   | .3389                                                                  | .4500                                                                  | $\frac{1}{2}$        | .030                                        |
| $\frac{3}{4}$ —18 | .6016                    | .6275                      | .542                                                                                                                                | .2222                                   | .3511                                                                  | .4622                                                                  | $\frac{9}{16}$       | .030                                        |
| $\frac{1}{2}$ —14 | .7451                    | .7783                      | .676                                                                                                                                | .2857                                   | .4628                                                                  | .6057                                                                  | $\frac{11}{16}$      | .040                                        |
| $\frac{3}{4}$ —14 | .9543                    | .9876                      | .886                                                                                                                                | .2857                                   | .4818                                                                  | .6247                                                                  | $\frac{23}{32}$      | .040                                        |
| 1—11½             | 1.1973                   | 1.2379                     | 1.118                                                                                                                               | .3478                                   | .5739                                                                  | .7478                                                                  | $\frac{7}{8}$        | .050                                        |
| 1½—11½            | 1.5408                   | 1.5814                     | 1.462                                                                                                                               | .3478                                   | .5939                                                                  | .7678                                                                  | $\frac{7}{8}$        | .050                                        |
| 1½—11½            | 1.7798                   | 1.8203                     | 1.701                                                                                                                               | .3478                                   | .5939                                                                  | .7678                                                                  | $\frac{7}{8}$        | .050                                        |
| 2—11½             | 2.2527                   | 2.2932                     | 2.174                                                                                                                               | .3478                                   | .6099                                                                  | .7838                                                                  | $\frac{7}{8}$        | .050                                        |
| 2½—8              | 2.6961                   | 2.7543                     | 2.590                                                                                                                               | .5000                                   | .9320                                                                  | 1.1820                                                                 | $1\frac{1}{2}$       | .050                                        |
| 3—8               | 3.3172                   | 3.3754                     | 3.214                                                                                                                               | .5000                                   | 1.0160                                                                 | 1.2660                                                                 | $1\frac{1}{2}$       | .050                                        |

\* Major diameter is based on crest minimum truncation of 0.20p.

† Maximum and minimum pitch-diameter steps are gaging limits. Notch formulas on drawing apply to all sizes.

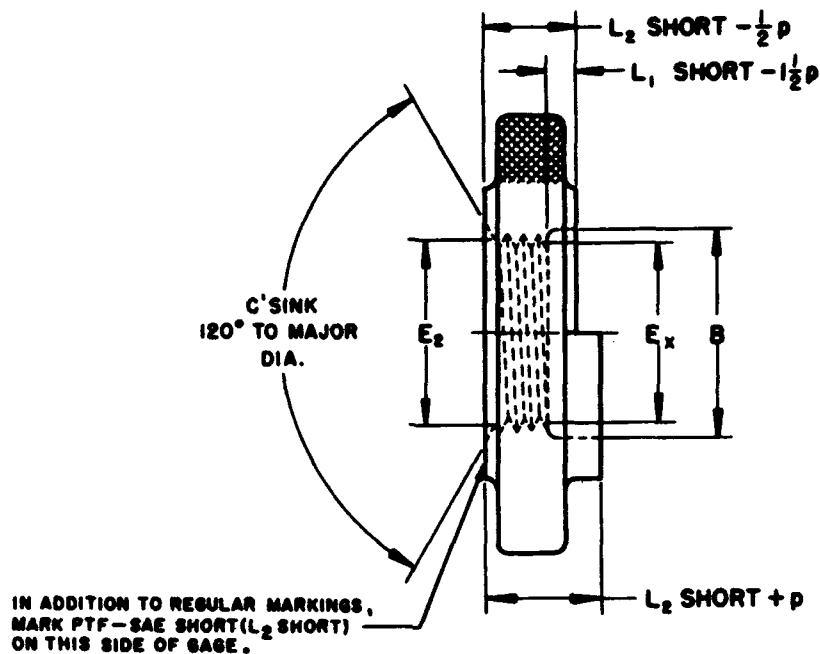
TABLE VIII.22.—Basic dimensions of Dryseal SAE short taper pipe thread ( $L_1$  short) step-limit thin-ring gages, PTF-SAE SHORT



| Size         | (L <sub>1</sub> short) step-limit thin-ring gages |                                                                |                                                            |                                |                               |                                                                  |                               |
|--------------|---------------------------------------------------|----------------------------------------------------------------|------------------------------------------------------------|--------------------------------|-------------------------------|------------------------------------------------------------------|-------------------------------|
|              | (L <sub>1</sub> short)                            | Max pitch diameter gaging step, (L <sub>1</sub> short - 1/2 p) | Min pitch diameter gaging step, (L <sub>1</sub> short + p) | Pitch diameter, E <sub>1</sub> | Minor diameter * at large end | Pitch diameter at min pitch diameter gaging step, E <sub>0</sub> | Minor diameter * at small end |
| 1            | 2                                                 | 3                                                              | 4                                                          | 5                              | 6                             | 7                                                                | 8                             |
|              | in.                                               | in.                                                            | in.                                                        | in.                            | in.                           | in.                                                              | in.                           |
| 3/16-27      | 0.12296                                           | 0.10444                                                        | 0.1600                                                     | 0.28118                        | 0.26392                       | 0.27118                                                          | 0.25392                       |
| 1/8-27       | .12446                                            | .10594                                                         | .1615                                                      | .37360                         | .35634                        | .36351                                                           | .34625                        |
| 1/4-18       | .17224                                            | .14446                                                         | .2278                                                      | .49163                         | .46574                        | .47739                                                           | .45150                        |
| 3/8-18       | .18444                                            | .15666                                                         | .2400                                                      | .62701                         | .60112                        | .61201                                                           | .58712                        |
| 1/2-14       | .24857                                            | .21286                                                         | .3200                                                      | .77843                         | .74514                        | .75843                                                           | .72514                        |
| 3/4-14       | .26757                                            | .23186                                                         | .3390                                                      | .98887                         | .95558                        | .96766                                                           | .93439                        |
| 1-11 1/2     | .31304                                            | .26956                                                         | .4000                                                      | 1.23863                        | 1.19810                       | 1.21363                                                          | 1.17310                       |
| 1 1/4-11 1/2 | .33304                                            | .28956                                                         | .4200                                                      | 1.58338                        | 1.54285                       | 1.55713                                                          | 1.51660                       |
| 1 1/2-11 1/2 | .33304                                            | .28956                                                         | .4200                                                      | 1.82234                        | 1.78181                       | 1.79609                                                          | 1.75556                       |
| 2-11 1/2     | .34904                                            | .30556                                                         | .4360                                                      | 2.29627                        | 2.25574                       | 2.26902                                                          | 2.22849                       |
| 2 1/2-8      | .55700                                            | .49450                                                         | .6820                                                      | 2.76216                        | 2.70991                       | 2.71953                                                          | 2.66128                       |
| 3-8          | .64100                                            | .57850                                                         | .7660                                                      | 3.38650                        | 3.33025                       | 3.34062                                                          | 3.28327                       |

\* Minor diameter is based on crest minimum truncation of 0.20p.

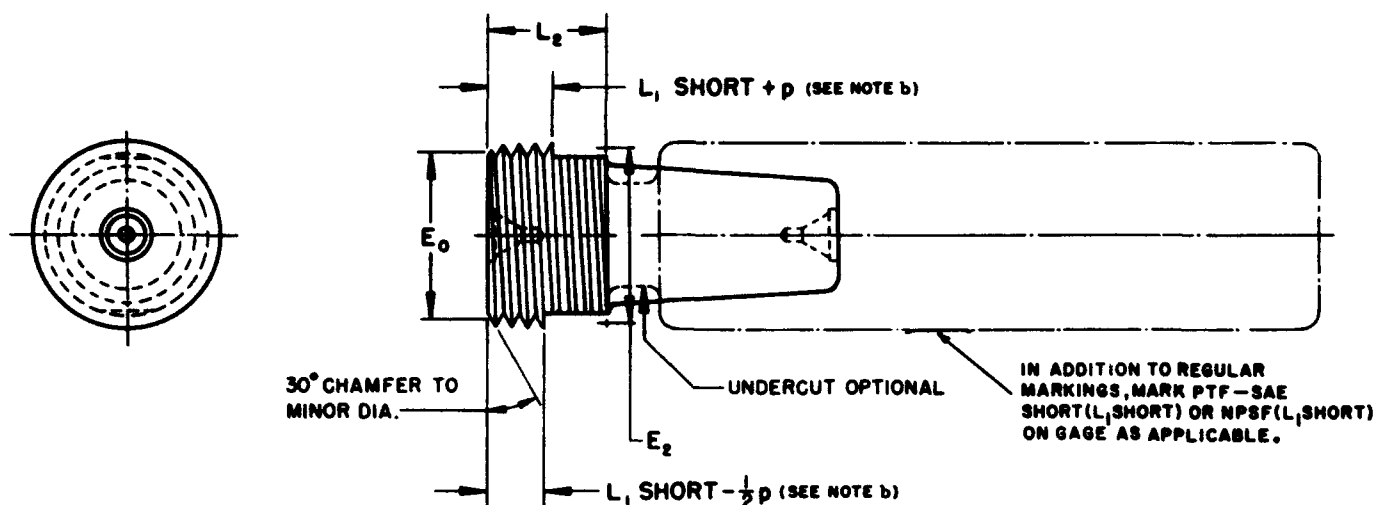
TABLE VIII.23.—Basic dimensions of Dryseal SAE short taper pipe thread ( $L_2$  short) step-limit full-ring gages, PTF-SAE SHORT



| Size                              | $(L_2 \text{ short})$ | $(L_2 \text{ short})$ step-limit full-ring gages                     |                                                           |                       |                             |                                                                                                   |                                       |                                      |                      |
|-----------------------------------|-----------------------|----------------------------------------------------------------------|-----------------------------------------------------------|-----------------------|-----------------------------|---------------------------------------------------------------------------------------------------|---------------------------------------|--------------------------------------|----------------------|
|                                   |                       | Max pitch diameter gaging step, $(L_2 \text{ short} - \frac{1}{2}p)$ | Min pitch diameter gaging step, $(L_2 \text{ short} + p)$ | Pitch diameter, $E_1$ | Minor diameter at large end | Pitch diameter at $(L_1 \text{ short} - \frac{3p}{2})$ from min pitch diameter gaging step, $E_2$ | Minor diameter at small end of c'bore | $(L_1 \text{ short} - \frac{3p}{2})$ | C'bore diameter, $B$ |
| 1                                 | 2                     | 3                                                                    | 4                                                         | 5                     | 6                           | 7                                                                                                 | 8                                     | 9                                    | 10                   |
|                                   | in.                   | in.                                                                  | in.                                                       | in.                   | in.                         | in.                                                                                               | in.                                   | in.                                  | in.                  |
| $\frac{1}{16}$ —27                | 0.2241                | 0.20557                                                              | 0.26113                                                   | 0.28750               | 0.27024                     | 0.27886                                                                                           | 0.26160                               | 0.06740                              | $\frac{3}{16}$       |
| $\frac{1}{8}$ —27                 | .2268                 | .20829                                                               | .26385                                                    | .28000                | .26274                      | .27129                                                                                            | .25403                                | .06890                               | $\frac{1}{2}$        |
| $\frac{1}{4}$ —18                 | .3462                 | .31845                                                               | .40178                                                    | .50250                | .47661                      | .48816                                                                                            | .46227                                | .08891                               | $\frac{1}{2}$        |
| $\frac{3}{8}$ —18                 | .3522                 | .32445                                                               | .40778                                                    | .63750                | .61161                      | .62354                                                                                            | .59765                                | .10111                               | $\frac{1}{2}$        |
| $\frac{1}{2}$ —14                 | .4623                 | .42657                                                               | .53371                                                    | .79179                | .75850                      | .77396                                                                                            | .74067                                | .14143                               | $\frac{3}{4}$        |
| $\frac{3}{4}$ —14                 | .4743                 | .43857                                                               | .54571                                                    | 1.00179               | .96850                      | .98440                                                                                            | .95111                                | .16043                               | $\frac{1}{2}$        |
| 1—11 $\frac{1}{2}$                | .5958                 | .55235                                                               | .66278                                                    | 1.25630               | 1.21577                     | 1.23320                                                                                           | 1.19267                               | .18260                               | $\frac{1}{2}$        |
| 1 $\frac{1}{4}$ —11 $\frac{1}{2}$ | .6196                 | .57635                                                               | .70678                                                    | 1.60130               | 1.56077                     | 1.57794                                                                                           | 1.53741                               | .20260                               | $\frac{1}{2}$        |
| 1 $\frac{1}{2}$ —11 $\frac{1}{2}$ | .6365                 | .59305                                                               | .72348                                                    | 1.84130               | 1.80077                     | 1.81690                                                                                           | 1.77637                               | .20260                               | $\frac{1}{2}$        |
| 2—11 $\frac{1}{2}$                | .6695                 | .62609                                                               | .75662                                                    | 2.31630               | 2.27577                     | 2.29084                                                                                           | 2.25031                               | .21860                               | $\frac{1}{2}$        |
| 2 $\frac{1}{2}$ —8                | 1.0125                | .95000                                                               | 1.13750                                                   | 2.79062               | 2.73237                     | 2.75434                                                                                           | 2.69609                               | .36950                               | $\frac{1}{2}$        |
| 3—8                               | 1.0750                | 1.01250                                                              | 1.20000                                                   | 3.41562               | 3.35737                     | 3.38068                                                                                           | 3.32243                               | .45350                               | $\frac{1}{2}$        |

\* Minor diameter is based on crest minimum truncation of 0.20p.

TABLE VIII. 24.—Basic dimensions of Dryseal SAE short taper pipe thread and Dryseal American Standard fuel internal straight pipe thread ( $L_1$  short) step-limit plug gages, PTF-SAE SHORT and NPSF

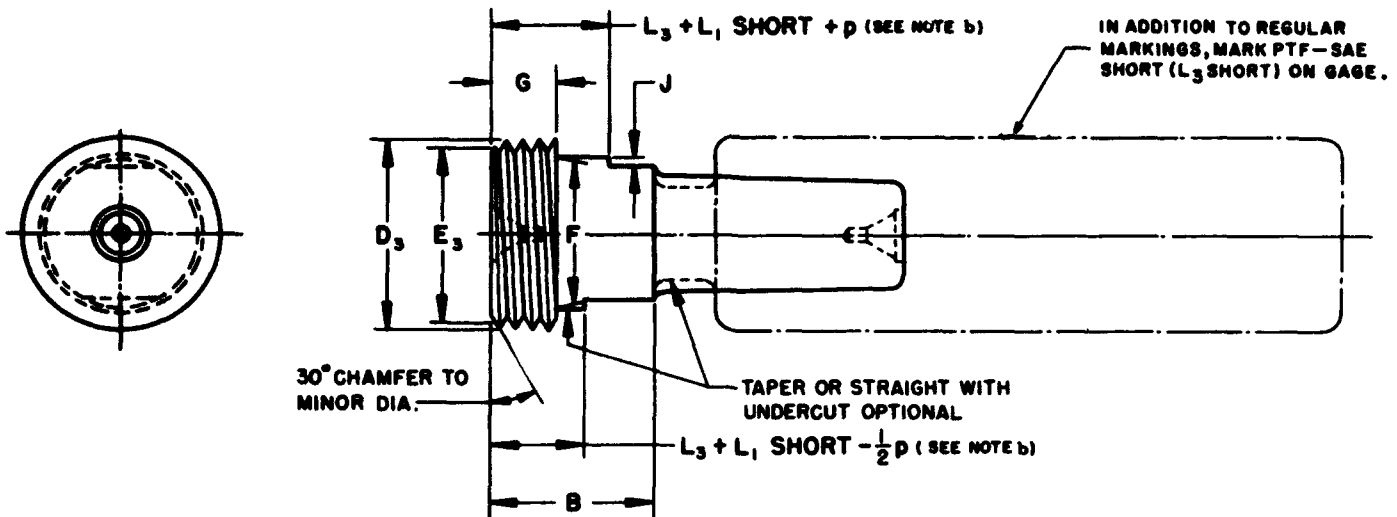


| Size              | $(L_1 \text{ Short})$ | $L_2$          | Small end             |                  | Min PD gaging step                   |                | Max PD gaging step        |                | Large end             |                  |
|-------------------|-----------------------|----------------|-----------------------|------------------|--------------------------------------|----------------|---------------------------|----------------|-----------------------|------------------|
|                   |                       |                | Pitch diameter, $E_0$ | Major diameter * | $(L_1 \text{ Short} - \frac{1}{2}p)$ | Pitch diameter | $(L_1 \text{ Short} + p)$ | Pitch diameter | Pitch diameter, $E_2$ | Major diameter * |
| 1                 | 2                     | 3              | 4                     | 5                | 6                                    | 7              | 8                         | 9              | 10                    | 11               |
| $\frac{1}{8}$ —27 | in.<br>0.12296        | in.<br>0.20113 | in.<br>0.27118        | in.<br>0.28944   | in.<br>0.10444                       | in.<br>0.27771 | in.<br>0.1600             | in.<br>0.28118 | in.<br>0.28750        | in.<br>0.30476   |
| $\frac{1}{4}$ —27 | .12446                | .26385         | .26351                | .28077           | .10594                               | .27013         | .1615                     | .27360         | .28000                | .29726           |
| $\frac{1}{4}$ —18 | .17224                | .40178         | .47739                | .50328           | .14446                               | .48642         | .2278                     | .49163         | .50250                | .52639           |
| $\frac{3}{8}$ —18 | .18444                | .40778         | .61201                | .63790           | .15666                               | .62180         | .2400                     | .62701         | .63750                | .66339           |
| $\frac{1}{2}$ —14 | .24857                | .53371         | .75843                | .79170           | .21286                               | .77174         | .3200                     | .77843         | .79179                | .82506           |
| $\frac{3}{4}$ —14 | .26757                | .54571         | .96768                | 1.00095          | .23186                               | .98218         | .3390                     | .98987         | 1.00179               | 1.03506          |
| 1—11½             | .31304                | .68278         | 1.21363               | 1.25416          | .26956                               | 1.23048        | .4000                     | 1.23863        | 1.25630               | 1.29683          |
| 1¼—11½            | .33304                | .70678         | 1.55713               | 1.59766          | .28956                               | 1.57523        | .4200                     | 1.58338        | 1.60130               | 1.64183          |
| 1½—11½            | .33304                | .72348         | 1.79609               | 1.83662          | .28956                               | 1.81419        | .4200                     | 1.82234        | 1.84130               | 1.88183          |
| 2—11½             | .34904                | .75652         | 2.26902               | 2.30955          | .30556                               | 2.28812        | .4360                     | 2.29627        | 2.31630               | 2.35683          |
| 2½—8              | .55700                | 1.13750        | 2.71953               | 2.77778          | .49450                               | 2.75044        | .6820                     | 2.76216        | 2.79062               | 2.84887          |
| 3—8               | .64100                | 1.20000        | 3.34062               | 3.39887          | .57850                               | 3.37678        | .7660                     | 3.38850        | 3.41562               | 3.47387          |

\* Major diameter is based on crest minimum truncation of 0.20 $p$ .  
 \* Maximum and minimum pitch-diameter steps are gaging limits. Notch formulas on drawing apply to all sizes.

\* For reference only above 1—11½ size.

TABLE VIII.25.—Basic dimensions of Dryseal SAE short taper pipe thread ( $L_3$  short) step-limit plug gages, PTF-SAE SHORT

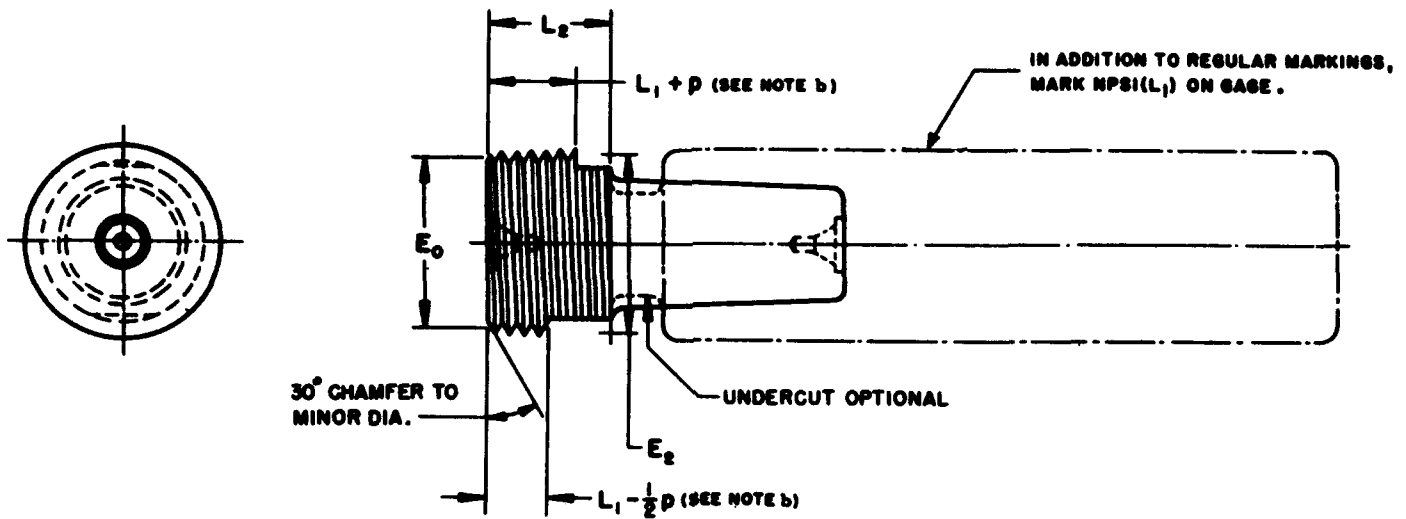


| Size               | Small end                  |                             | Relief diameter<br>( $E_3 + 0.0625 \times 4p$ —<br>sharp-V thd hgt<br>—0.020 to 0.025 be-<br>low sharp root);<br>$F + 0.005$ , —0.000 | Four threads,<br>$G$ , ( $L_3 + p$ ) | Min PD gag-<br>ing step+3<br>thds, ( $L_3 +$<br>$L_1$ short<br>— $p/2$ ) | Max PD gag-<br>ing step+3<br>thds, ( $L_3 +$<br>$L_1$ short<br>+ $p$ ) | Blank length,<br>$B$         | Notch depth,<br>$J + 0.005$ ,<br>—0.000 |
|--------------------|----------------------------|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|--------------------------------------------------------------------------|------------------------------------------------------------------------|------------------------------|-----------------------------------------|
|                    | Pitch diam-<br>eter, $E_3$ | Major diam-<br>eter,* $D_3$ |                                                                                                                                       |                                      |                                                                          |                                                                        |                              |                                         |
| 1                  | 2                          | 3                           | 4                                                                                                                                     | 5                                    | 6                                                                        | 7                                                                      | 8                            | 9                                       |
| $\frac{1}{16}$ —27 | <i>in.</i><br>0.2642       | <i>in.</i><br>0.2815        | <i>in.</i><br>0.216                                                                                                                   | <i>in.</i><br>0.1482                 | <i>in.</i><br>0.2156                                                     | <i>in.</i><br>0.2711                                                   | <i>in.</i><br>$\frac{3}{16}$ | <i>in.</i><br>0.030                     |
| $\frac{1}{8}$ —27  | .3566                      | .3738                       | .309                                                                                                                                  | .1482                                | .2171                                                                    | .2726                                                                  | $\frac{13}{32}$              | .030                                    |
| $\frac{1}{4}$ —18  | .4670                      | .4928                       | .409                                                                                                                                  | .2222                                | .3111                                                                    | .3945                                                                  | $\frac{1}{2}$                | .030                                    |
| $\frac{3}{8}$ —18  | .6016                      | .6275                       | .542                                                                                                                                  | .2222                                | .3233                                                                    | .4067                                                                  | $\frac{9}{16}$               | .030                                    |
| $\frac{1}{2}$ —14  | .7451                      | .7783                       | .676                                                                                                                                  | .2857                                | .4271                                                                    | .5343                                                                  | $\frac{11}{16}$              | .040                                    |
| $\frac{3}{4}$ —14  | .9543                      | .9876                       | .886                                                                                                                                  | .2857                                | .4462                                                                    | .5533                                                                  | $\frac{23}{32}$              | .040                                    |
| 1—11½              | 1.1973                     | 1.2379                      | 1.118                                                                                                                                 | .3478                                | .5304                                                                    | .6609                                                                  | $\frac{7}{8}$                | .050                                    |
| 1½—11½             | 1.5408                     | 1.5814                      | 1.462                                                                                                                                 | .3478                                | .5504                                                                    | .6809                                                                  | $\frac{7}{8}$                | .050                                    |
| 1½—11½             | 1.7798                     | 1.8203                      | 1.701                                                                                                                                 | .3478                                | .5504                                                                    | .6809                                                                  | $\frac{7}{8}$                | .050                                    |
| 2—11½              | 2.2527                     | 2.2932                      | 2.174                                                                                                                                 | .3478                                | .5664                                                                    | .6969                                                                  | $\frac{7}{8}$                | .050                                    |
| 2½—8               | 2.6961                     | 2.7543                      | 2.590                                                                                                                                 | .5000                                | .8695                                                                    | 1.0570                                                                 | $\frac{11}{2}$               | .050                                    |
| 3—8                | 3.3172                     | 3.3754                      | 3.214                                                                                                                                 | .5000                                | .9535                                                                    | 1.1410                                                                 | $\frac{11}{2}$               | .050                                    |

\* Major diameter is based upon crest minimum truncation of  $0.20p$ .

<sup>b</sup> Maximum and minimum pitch-diameter steps are gaging limits. Notch formulas on drawing apply to all sizes.

TABLE VIII.26.—Basic dimensions of Dryseal American Standard intermediate internal straight pipe thread ( $L_1$ ) step-limit plug gages, NPSI



| Size               | $L_1$         | $L_2$          | Small end             |                  | Min PD gaging step |                | Max PD gaging step |                | Large end             |                  |
|--------------------|---------------|----------------|-----------------------|------------------|--------------------|----------------|--------------------|----------------|-----------------------|------------------|
|                    |               |                | Pitch diameter, $E_0$ | Major diameter * | $(L_1 - p/2)$      | Pitch diameter | $(L_1 + p)$        | Pitch diameter | Pitch diameter, $E_2$ | Major diameter * |
| 1                  | 2             | 3              | 4                     | 5                | 6                  | 7              | 8                  | 9              | 10                    | 11               |
| $\frac{1}{16}$ —27 | in.<br>0.1600 | in.<br>0.26113 | in.<br>0.27118        | in.<br>0.28844   | in.<br>0.14148     | in.<br>0.28002 | in.<br>0.19704     | in.<br>0.28350 | in.<br>0.28750        | in.<br>0.30476   |
| $\frac{1}{8}$ —27  | .1615         | .26385         | .36351                | .38077           | .14298             | .37245         | .19854             | .28592         | .38000                | .39726           |
| $\frac{1}{4}$ —18  | .2278         | .40178         | .47739                | .50328           | .20002             | .48989         | .28336             | .49510         | .50250                | .52639           |
| $\frac{3}{8}$ —18  | .2400         | .40778         | .61201                | .63790           | .21222             | .62527         | .29556             | .63048         | .63750                | .66339           |
| $\frac{1}{2}$ —14  | .3200         | .53371         | .75843                | .79170           | .28428             | .77620         | .39143             | .78289         | .79179                | .82506           |
| $\frac{3}{4}$ —14  | .3390         | .54571         | .96768                | 1.00095          | .30328             | .98664         | .41043             | .99333         | 1.00179               | 1.03506          |
| 1—11½              | .4000         | .68278         | 1.21363               | 1.25416          | .35652             | 1.23592        | .49696             | 1.24406        | 1.25630               | 1.29683          |
| 1¼—11½             | .4200         | .70678         | 1.55713               | 1.59766          | .37652             | 1.58066        | .50696             | 1.58882        | 1.60130               | 1.64183          |
| 1½—11½             | .4200         | .72348         | 1.79609               | 1.83662          | .37652             | 1.81962        | .50696             | 1.82778        | 1.84130               | 1.88183          |
| 2—11½              | .4360         | .75652         | 2.26902               | 2.30955          | .39252             | 2.29355        | .52296             | 2.30170        | 2.31630               | 2.35683          |
| 2½—8               | .6820         | 1.13750        | 2.71953               | 2.77778          | .61950             | 2.75825        | .80700             | 2.76997        | 2.79062               | 2.84887          |
| 3—8                | .7660         | 1.20000        | 3.34062               | 3.39687          | .70350             | 3.38459        | .89100             | 3.39631        | 3.41562               | 3.47387          |

\* Major diameter is based on crest minimum truncation of 0.20p.  
 \* Maximum and minimum pitch-diameter steps are gaging limits. Notch formulas on drawing apply to all sizes.

\* For reference only above 1—11½ size.

## SECTION IX. GAS CYLINDER VALVE OUTLET AND INLET THREADS<sup>1</sup>

### 1. INTRODUCTION

1. GENERAL.—The first efforts to develop standards for compressed gas cylinder valve threads followed immediately after World War I, and were inspired by the difficulties encountered both by industry and the military services because of the multiplicity of connections that were then in use.

Through the activity of the Gas Cylinder Valve Thread Committee of the Compressed Gas Manufacturers' Association, Inc., material progress was made through the years that followed, with the result that, when the United States became involved in World War II, the gas industries themselves had materially improved this situation. Several of the compressed gas industries had achieved virtual standardization at tremendous cost for replacement of valve equipment. Their standards, however, were not completely formalized nor fully coordinated with other related standards. Much of the progress between World War I and World War II was the result of interest in the problem by the Federal Specifications Board.

The circumstances surrounding industrial and military users of compressed gases during World War II brought into clear focus the need for acceleration of the standardizing project for cylinder valve threads. They created not only the necessity but also a splendid opportunity for the compressed gas industry, the Military services, and other Federal agencies to study cooperatively the standardizing problems of valve outlet threads. These studies resulted in closer definition and appreciation of each valve outlet and in a more balanced relationship between the many types and sizes.

When the Standards Associations representing Great Britain, Canada, and the United States met in Ottawa in October 1945 to consider unification of screw threads, a fairly well developed plan for standardization of compressed gas cylinder valve threads was presented to the Conference by the Valve Thread Standardization Committee of the Compressed Gas Manufacturers' Association, Inc. (CGMA). These proposed standards represented the experience and knowledge of compressed gas manufacturers, valve manufacturers, and the needs and requirements of varied users of gas cylinder valves, including the military services and other Federal agencies. Approval of these standards to the extent to which they were then developed was given by the U.S. Department of Commerce, the U.S. Army, and the U.S. Navy

through the Interdepartmental Screw Thread Committee following a joint meeting with the representatives of CGMA in August 1945. Much progress was made later in that year at the Canadian Section Meeting of CGMA tending to unify United States and Canadian practices. During January 1946 through conference between representatives of the CGMA Valve Thread Standardization Committee<sup>2</sup> and the Interdepartmental Screw Thread Committee in Washington, agreements were reached that resulted in final approval of considerable additional gas cylinder valve thread data. These data were included in the 1950 supplement to Handbook H28. This issue of H28 includes more detailed data on the outlet and inlet connections than were previously shown.

2. MEDICAL GAS CYLINDER VALVE CONNECTIONS.—As early as 1940 it was evident to various medical societies, as well as to the manufacturers of medical gases, that a system should be devised to prevent the interchangeability of medical gas cylinders equipped with flush-type valves when used with medical gas administering apparatus. Various means for accomplishing this were studied. The most difficult obstacle to be overcome was that of devising a system that would permit the adjustment of existing apparatus without interfering with its use and without requiring that it be returned to the manufacturer for conversion. The system contained in these standards, and known as "The Pin-Index Safety System for Flush-Type Cylinder Valves" is the result of the concerted efforts of the companies and organizations concerned. This standard has been submitted to Technical Committee No. 58 of the International Organization for Standardization as a proposed International Standard.

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

### 2. OUTLET CONNECTIONS

Figures IX.1 through IX.34 show the details of the valve outlet connections included in this section. The outlet connections are designated by their commercial designations and are arranged in numerical sequence. On each figure are listed the gases with which the valve outlet connection shown on that figure is to be used. Table IX.1 consists of an alphabetical list of gases cross-referenced with the valve outlet connection numbers and figure numbers.

<sup>1</sup> This section is substantially in agreement with the present issue of ASA B57.1, "American Standard Compressed Gas Cylinder Valve Outlet and Inlet Connections," which is published by the Compressed Gas Association, Inc., 11 West 42d Street, New York 36, N.Y. The latest revision should be consulted when referring to this ASA standard.

<sup>2</sup> The Compressed Gas Manufacturers' Association, Inc. changed its name in January 1949 and its Valve Thread Standardization Committee became the Valve Thread Standards Committee of Compressed Gas Association, Inc.

**TABLE IX.1.—Alphabetical list of gases with valve outlet connection numbers**

| Gas                                                                               | Standard connection            |               | Alternate connection *         |               |
|-----------------------------------------------------------------------------------|--------------------------------|---------------|--------------------------------|---------------|
|                                                                                   | Valve outlet connection number | Figure        | Valve outlet connection number | Figure        |
| Acetylene                                                                         | 510                            | IX. 14        | 300                            | IX. 7         |
| Acetylene, small valve series                                                     | 200                            | IX. 3         | 520                            | IX. 15        |
| Air, water-pumped                                                                 | 580                            | IX. 17        |                                |               |
| Air, oil-pumped                                                                   | 590                            | IX. 18        |                                |               |
| Ammonia, anhydrous *                                                              | 240, 380                       | IX. 4, IX. 13 | 260                            | IX. 5         |
| Ammonia, anhydrous, yoke connection                                               | 800                            | IX. 23        |                                |               |
| Argon, water-pumped                                                               | 580                            | IX. 17        |                                |               |
| Argon, oil-pumped                                                                 | 590                            | IX. 18        |                                |               |
| Boron trifluoride                                                                 | 330                            | IX. 9         |                                |               |
| Bromochloromethane                                                                | 620                            | IX. 19        |                                |               |
| Butadiene                                                                         | 510                            | IX. 14        |                                |               |
| Butane                                                                            | 510                            | IX. 14        | 350, 300                       | IX. 11, IX. 7 |
| Carbon dioxide                                                                    | 320                            | IX. 8         |                                |               |
| Carbon dioxide, medical, yoke connection                                          | 940                            | IX. 34        |                                |               |
| Carbon dioxide-ethylene oxide mixtures                                            | 350                            | IX. 11        |                                |               |
| Carbon dioxide-oxygen mixture (CO <sub>2</sub> over 7%), medical, yoke connection | 940                            | IX. 34        |                                |               |
| Carbon monoxide                                                                   | 350                            | IX. 11        |                                |               |
| Chlorine                                                                          | 660                            | IX. 21        |                                |               |
| Chlorine, yoke connection, washer on outer face                                   | 820                            | IX. 24        |                                |               |
| Chlorine, yoke connection, washer inside of recess                                | 840                            | IX. 25        |                                |               |
| Chlorine trifluoride                                                              | 670                            | IX. 22        |                                |               |
| Cyclopropane, medical, yoke connection                                            | 920                            | IX. 32        |                                |               |
| Cyclopropane, industrial                                                          | 510                            | IX. 14        |                                |               |
| Dichlorodifluoromethane                                                           | 620                            | IX. 19        |                                |               |
| Dichlorodifluoromethane-difluoroethane mixture                                    | 620                            | IX. 19        |                                |               |
| Difluorodibromoethane                                                             | 620                            | IX. 19        |                                |               |
| Difluoroethane                                                                    | 660                            | IX. 21        |                                |               |
| Difluoromonochloroethane                                                          | 660                            | IX. 21        |                                |               |
| Dimethylamine, anhydrous                                                          | 240                            | IX. 4         |                                |               |
| Dimethyl ether                                                                    | 510                            | IX. 14        |                                |               |
| Ethane                                                                            | 350                            | IX. 11        |                                |               |
| Ethyl chloride                                                                    | 300                            | IX. 7         |                                |               |
| Ethylene, industrial and medical                                                  | 350                            | IX. 11        |                                |               |
| Ethylene, medical, yoke connection                                                | 900                            | IX. 30        |                                |               |
| Ethylene oxide                                                                    | 510                            | IX. 14        | 350                            | IX. 11        |
| Fluorine                                                                          | 670                            | IX. 22        |                                |               |
| Helium, water-pumped                                                              | 580                            | IX. 17        |                                |               |
| Helium, medical, yoke connection                                                  | 930                            | IX. 33        |                                |               |
| Helium, oil-pumped                                                                | 590                            | IX. 18        | 350                            | IX. 11        |
| Helium-oxygen mixture (O <sub>2</sub> less than 20%), medical, yoke connection    | 930                            | IX. 33        |                                |               |
| Hydrogen                                                                          | 350                            | IX. 11        |                                |               |
| Hydrogen chloride, anhydrous                                                      | 330                            | IX. 9         |                                |               |
| Hydrogen cyanide, anhydrous                                                       | 160                            | IX. 2         |                                |               |
| Hydrogen fluoride, anhydrous                                                      | 670                            | IX. 22        |                                |               |
| Hydrogen sulphide                                                                 | 330                            | IX. 9         |                                |               |
| Isobutane                                                                         | 510                            | IX. 14        | 350                            | IX. 11        |
| Krypton, water-pumped                                                             | 580                            | IX. 17        |                                |               |
| Krypton, water-pumped, small valve series                                         | 120                            | IX. 1         |                                |               |
| Krypton, oil-pumped                                                               | 580                            | IX. 18        |                                |               |
| Methane                                                                           | 350                            | IX. 11        |                                |               |
| Methyl bromide                                                                    | 620                            | IX. 19        | 340                            | IX. 10        |
| Methyl chloride                                                                   | 620                            | IX. 19        | 360                            | IX. 12        |
| Methyl mercaptan                                                                  | 330                            | IX. 9         |                                |               |
| Monochlorodifluoromethane                                                         | 620                            | IX. 19        |                                |               |
| Monochlorotetrafluoroethane                                                       | 620                            | IX. 19        |                                |               |
| Monochlorotrifluoromethane                                                        | 620                            | IX. 19        |                                |               |
| Monomethylamine, anhydrous                                                        | 240                            | IX. 4         |                                |               |
| Neon, water-pumped                                                                | 580                            | IX. 17        |                                |               |
| Neon, water-pumped, small valve series                                            | 120                            | IX. 1         |                                |               |
| Neon, oil-pumped                                                                  | 590                            | IX. 18        |                                |               |
| Nitrogen, water-pumped                                                            | 580                            | IX. 17        |                                |               |

**TABLE IX.1.—Alphabetical list of gases with valve outlet connection numbers—Continued**

| Gas                                                                                   | Standard connection            |        | Alternate connection *         |               |
|---------------------------------------------------------------------------------------|--------------------------------|--------|--------------------------------|---------------|
|                                                                                       | Valve outlet connection number | Figure | Valve outlet connection number | Figure        |
| Nitrogen, oil-pumped                                                                  | 590                            | IX. 18 |                                |               |
| Nitrous oxide                                                                         | 320                            | IX. 8  |                                |               |
| Nitrous oxide, medical, yoke connection                                               | 910                            | IX. 31 |                                |               |
| Oxygen, industrial and medical                                                        | 540                            | IX. 16 |                                |               |
| Oxygen, medical, yoke connection                                                      | 870                            | IX. 27 |                                |               |
| Oxygen-carbon dioxide mixture (CO <sub>2</sub> not over 7%), medical, yoke connection | 880                            | IX. 28 |                                |               |
| Oxygen-helium mixture (helium not over 80%), medical, yoke connection                 | 890                            | IX. 29 |                                |               |
| Phosgene                                                                              | 640                            | IX. 20 |                                |               |
| Phosgene, small valve series                                                          | 160                            | IX. 2  |                                |               |
| Propane                                                                               | 510                            | IX. 14 | 350, 300                       | IX. 11, IX. 7 |
| Propylene                                                                             | 510                            | IX. 14 | 350                            | IX. 11        |
| Sulphur dioxide                                                                       | 620                            | IX. 19 | 360                            | IX. 12        |
| Sulphur hexafluoride                                                                  | 590                            | IX. 18 |                                |               |
| Tetrafluoroethylene                                                                   | 620                            | IX. 19 |                                |               |
| Trifluorobromomethane                                                                 | 620                            | IX. 19 |                                |               |
| Trifluorochloroethylene, inhibited                                                    | 620                            | IX. 19 |                                |               |
| Trimethylamine, anhydrous                                                             | 240                            | IX. 4  |                                |               |
| Vinyl chloride, inhibited                                                             | 290                            | IX. 6  |                                |               |
| Vinyl methyl ether, inhibited                                                         | 290                            | IX. 6  |                                |               |
| Xenon, water-pumped                                                                   | 580                            | IX. 17 |                                |               |
| Xenon, water-pumped, small valve series                                               | 120                            | IX. 1  |                                |               |
| Xenon, oil-pumped                                                                     | 590                            | IX. 18 |                                |               |

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

\* Co-standards 240 and 380 have been established for anhydrous ammonia. Connection No. 240 is standard for the Federal services while No. 380 is the commercial standard.

**1. THREADS AND GAGING.**—Table IX.2 consists of a numerical listing of the valve outlet connections showing the connecting threads.

The threads on the outlets are separated into four basic divisions—internal and external (INT and EXT), as well as right-hand and left-hand (RH and LH). Within each of the four divisions, further separation is made by varying the pitch and diameter of the threads. The diameters within each division are so spaced that adjoining sizes either will not enter or will not engage.

As far as practicable, the design of connections and assignment of the connections to gases has been made so as to prevent the interchange of connections which may result in a hazard. With the exception of outlets having taper pipe threads which seal at the threads, each outlet provides for screw threads which do not seal but merely hold the nipple against its seat. These screw threads have the Unified form, but are not in the regular series.

Past practice has firmly established many outlet connections for specific gases or groups of gases and in many cases these connections were retained. Small differences in the threads and other elements of the same connection were reconciled into one form and size, properly recorded and defined. By adhering to existing outlets where practicable, it was possible to put the new standard system into effect without the inconvenience and expense of a cumbersome and costly changeover. Alternate and co-standards have been established for some gases.

Keeping the established practice in mind when classifying and assigning the gases to their outlets, an effort was made to follow a plan whereby right-hand threads would be used for non-fuel gases and for water-pumped gases, whereas left-hand threads would be used for fuel gases and for oil-pumped gases. These left-hand threads are

identified by a groove on the hexagon nut. An external thread is used on the valve in most cases, but some important groups of gases have an internal thread on the valve.

In general, as indicated by table IX.2, most of the connecting threads are of the National Gas Outlet (NGO) type. This symbol was suggested and designated by the Interdepartmental Screw Thread Committee to provide for the peculiar needs of the industry.

For the NGO thread an allowance (minimum clearance) of from 0.0020 to 0.0050 in. between the mating parts is established to provide the desired looseness of fit at the threads, and to assure interchangeability between products of different manufacturers, who lacked a common standard in the past. The tolerances are in the direction of greater looseness and are determined on the basis of NS-3 data, except for the major

TABLE IX.2.—Numerical listing of valve outlet connections showing the connecting threads

| Valve outlet connection number | Figure No. | Valve outlet |                                                                                                    | Mating assembly |                                                      | Nipple or pipe No. | Nut or converter No. | Washer No. |
|--------------------------------|------------|--------------|----------------------------------------------------------------------------------------------------|-----------------|------------------------------------------------------|--------------------|----------------------|------------|
|                                |            | No.          | Thread                                                                                             | No.             | Thread                                               |                    |                      |            |
| 1                              | 2          | 3            | 4                                                                                                  | 5               | 6                                                    | 7                  | 8                    | 9          |
| 120                            | IX. 1      | 121          | .375-24NGO-RH-EXT                                                                                  | 122             | .375-24NGO-RH-INT                                    | 123                | 124                  |            |
| 160                            | IX. 2      | 161          | 1/4-27NGT-RH-INT                                                                                   | 162             | 1/4-27NGT-RH-EXT                                     | 163                |                      |            |
| 200                            | IX. 3      | 201          | .625-20NGO-RH-EXT                                                                                  | 202             | .625-20NGO-RH-INT                                    | 203                | 204                  |            |
| 240                            | IX. 4      | 241          | 3/4-18NGT-RH-INT                                                                                   | 242             | 3/4-18NPT-RH-EXT                                     | 243                | 244                  | 245        |
| 260                            | IX. 5      | 261          | 3/4-18NGT-RH-INT (with 1" nut)                                                                     | 262             | 3/4-18NPT-RH-EXT (with 1" nut)                       | 263                | 264                  | 265        |
| 290                            | IX. 6      | 291          | .745-14NGO-LH-EXT                                                                                  | 292             | .750-14NGO-LH-INT                                    | 293                | 294                  |            |
| 300                            | IX. 7      | 301          | .825-14NGO-RH-EXT (for conical nipple)                                                             | 302             | .830-14NGO-RH-INT (conical nipple)                   | 303                | 304                  |            |
| 320                            | IX. 8      | 321          | .825-14NGO-RH-EXT (for flat nipple)                                                                | 322             | .830-14NGO-RH-INT (flat nipple)                      | 323                | 324                  | 325        |
| 330                            | IX. 9      | 331          | .825-14NGO-LH-EXT (for flat nipple)                                                                | 332             | .830-14NGO-LH-INT (flat nipple)                      | 333                | 334                  | 335        |
| 340                            | IX. 10     | 341          | 1/2-14NGT-RH-EXT                                                                                   | 342             | 1/2-14NGT-RH-INT                                     | 343                | 344                  |            |
| 350                            | IX. 11     | 351          | .875-14NGO-LH-EXT (for round nipple)                                                               | 352             | .830-14NGO-LH-INT (round nipple)                     | 353                | 354                  |            |
| 360                            | IX. 12     | 361          | 1/2-14NGT-RH-EXT                                                                                   | 362             | 1/2-14NGT-RH-INT                                     |                    | 364                  | 365        |
| 380                            | IX. 13     | 381          | 1/2-14NGT-RH-INT                                                                                   | 382             | 1/2-14NPT-RH-EXT                                     | 383                | 384                  | 385        |
| 510                            | IX. 14     | 511          | .885-14NGO-LH-INT                                                                                  | 512             | .880-14NGO-LH-EXT                                    | 513                | 514                  |            |
| 520                            | IX. 15     | 521          | .885-18NGO-RH-EXT                                                                                  | 522             | .899-18NGO-RH-INT                                    | 523                | 524                  |            |
| 540                            | IX. 16     | 541          | .903-14NGO-RH-EXT                                                                                  | 542             | .908-14NGO-RH-INT                                    | 543                | 544                  |            |
| 580                            | IX. 17     | 581          | .965-14NGO-RH-INT                                                                                  | 582             | .960-14NGO-RH-EXT                                    | 583                | 584                  |            |
| 590                            | IX. 18     | 591          | .965-14NGO-LH-INT                                                                                  | 592             | .960-14NGO-LH-EXT                                    | 593                | 594                  |            |
| 620                            | IX. 19     | 621          | 1.030-14NGO-RH-EXT (with groove)                                                                   | 622             | 1.035-14NGO-RH-INT (with flare converter)            |                    | 624                  | 625        |
| 640                            | IX. 20     | 641          | 1.030-14NGO-RH-EXT (with 1/4-27NGT-RH-INT)                                                         | 642             | 1.035-14NGO-RH-INT (with 3/4-18NGT-RH-EXT converter) |                    | 644                  | 645        |
| 660                            | IX. 21     | 661          | 1.030-14NGO-RH-EXT (without groove)                                                                | 662             | 1.035-14NGO-RH-INT (with nut and nipple)             | 663                | 664                  | 665        |
| 670                            | IX. 22     | 671          | 1.030-14NGO-LH-EXT                                                                                 | 672             | 1.035-14NGO-LH-INT                                   | 673                | 674                  | 675        |
| 800                            | IX. 23     | 801          | Yoke outlet for: Ammonia, anhydrous.                                                               | 802             | Yoke connection                                      | 803                |                      | 805        |
| 820                            | IX. 24     | 821          | Chlorine                                                                                           | 822             | Yoke connection (with washer on outer face)          | 823                |                      | 825        |
| 840                            | IX. 25     | 841          | Chlorine                                                                                           | 842             | Yoke connection (with washer inside of recess)       | 843                |                      | 845        |
| 870                            | IX. 27     | 871          | Oxygen, medical                                                                                    | 872             | Yoke connection                                      | 873                |                      | 875        |
| 880                            | IX. 28     | 881          | O <sub>2</sub> -CO <sub>2</sub> mixture (CO <sub>2</sub> not over 7%), medical.                    | 882             | Yoke connection                                      | 883                |                      | 875        |
| 890                            | IX. 29     | 891          | Oxygen-helium mixtures (helium not over 80%), medical.                                             | 892             | Yoke connection                                      | 893                |                      | 875        |
| 900                            | IX. 30     | 901          | Ethylene, medical                                                                                  | 902             | Yoke connection                                      | 903                |                      | 875        |
| 910                            | IX. 31     | 911          | Nitrous oxide, medical                                                                             | 912             | Yoke connection                                      | 913                |                      | 875        |
| 920                            | IX. 32     | 921          | Cyclopropane, medical                                                                              | 922             | Yoke connection                                      | 923                |                      | 875        |
| 930                            | IX. 33     | 931          | Helium, medical; and helium-oxygen mixture (O <sub>2</sub> less than 20%), medical.                | 932             | Yoke connection                                      | 933                |                      | 875        |
| 940                            | IX. 34     | 941          | CO <sub>2</sub> , medical; and CO <sub>2</sub> -oxygen mixture (CO <sub>2</sub> over 7%), medical. | 942             | Yoke connection                                      | 943                |                      | 875        |

Each complete outlet connection is different. However, one or more of its components may be the same as those used on other connections, as follows:

Valve outlets: 241 and 801 are identical. 661, 821, and 841 are identical. 621 and 641 are similar.

Nipples: 243 (Plain pipe connection) and 263 are identical. 323 and 333 are identical. 513, 583, and 593 are identical. 663 and 673 are identical. Nuts: 304 and 324 are identical. 334 and 354 are identical. Washers: 325 and 335 are identical. 625 and 645 are identical.

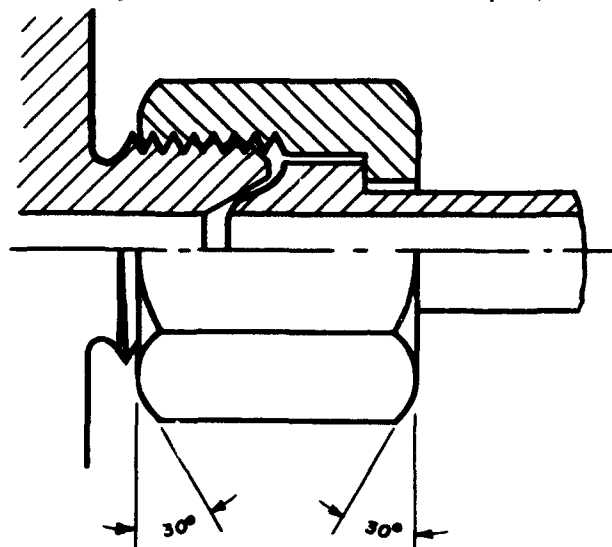
diameter of the external threads for which the tolerance is limited to 0.0050 in. instead of 0.0098 in.

In addition to the NGO threads, other types of threads are used on the outlet connections as connecting threads or in the valve body. The types of threads specified on figures IX.1 through IX.34 are listed in table IX.3 along with references as to where information on limits of size and gaging of these threads may be found.

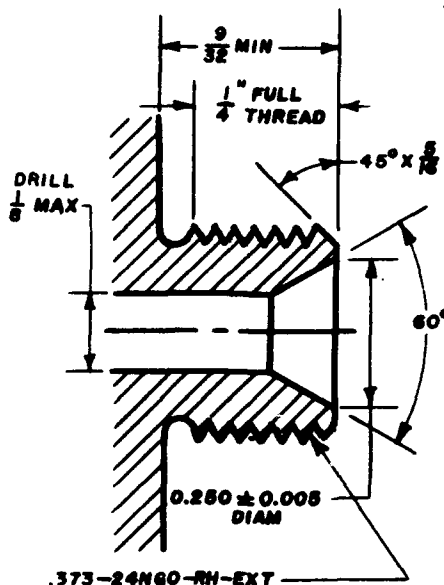
TABLE IX.3.—Types of threads used in valve outlet connections cross-referenced with limits of size and gaging information for the threads

| Type of thread | Limits of size of thread *           | Gages and gaging *             |
|----------------|--------------------------------------|--------------------------------|
| NGO            | Table IX.4, p. 76                    | Section VI of Part I.          |
| NGT            | Table IX.5, p. 76                    | Par. 1(b), p. 77.              |
| NPSM           | Table VII.6, p. 9                    | Section VII, par. 8, p. 11.    |
| NPT            | Tables VII.1 and VII.2, pp. 4 and 5. | Section VII, par. 8, p. 11.    |
| 1-14NS         | Table 1.9, p. 136 of Part I          | Table 1.16, p. 152 of Part I.  |
| UNF            | Table III.10, p. 27 of Part I        | Table III.12, p. 39 of Part I. |

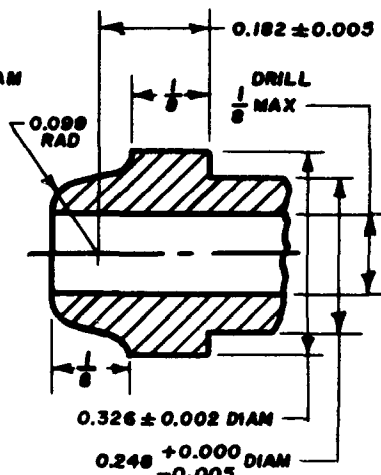
\* See also par. 1, threads and gaging, p. 44.



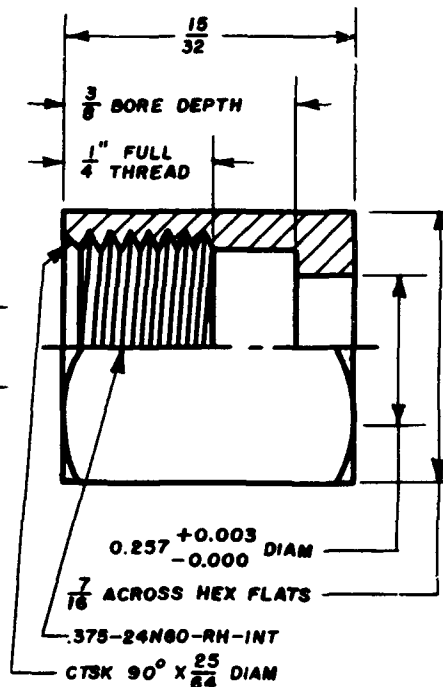
CONNECTION NO. 120



VALVE OUTLET NO. 121



NIPPLE NO. 123



HEX NUT NO. 124

Standard outlet connection for:  
Krypton, water-pumped, small valve series  
Neon, water-pumped, small valve series  
Xenon, water-pumped, small valve series

Dimensions in inches unless otherwise specified.

FIGURE IX.1.—No. 120 valve outlet connection, .373-24NGO-RH-EXT thread.

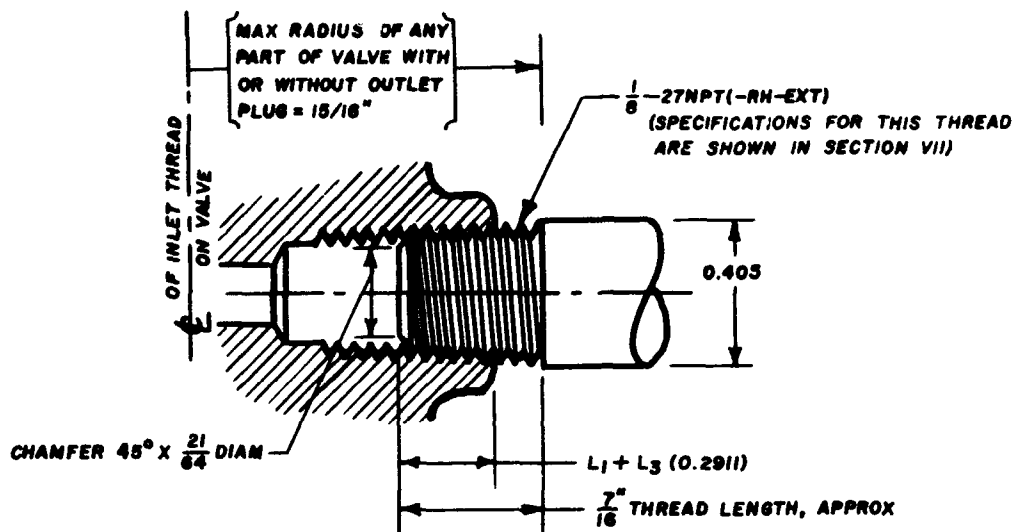
For purposes of clarity and consistency, all threads shown on figures IX.1 through IX.34 have RH-EXT(INT) in the thread designation even though it may not be required for proper thread identification.

2. CLEARANCE.—The maximum radius of any part of the valve from its centerline has been specified to insure clearance for the smallest (3/4-in.) standard cylinder valve protecting cap.

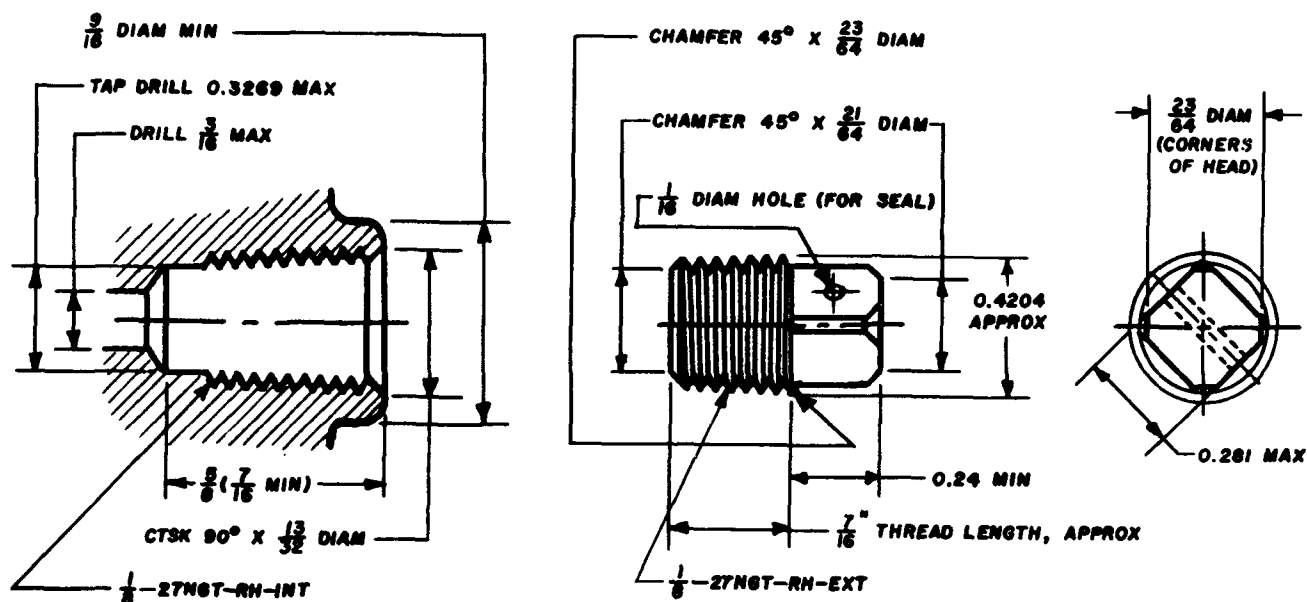
3. NUMBERING SYSTEM.—The last digit of the designating numbers for the outlet connections

and components shown in figures IX.1 through IX.34 has the following significance:

- 0—complete outlet connection,
- 1—valve outlet,
- 2—mating assembly (see table IX.2),
- 3—nipple or pipe,
- 4—nut or converter,
- 5—washer,
- 9—plug.



**PIPE CONNECTION NO. 163**



**VALVE OUTLET NO. 161**

(USED WITH SEALED TRANSIT CAP WITH 2 3/8\"/>

**PLUG NO. 169**

Standard outlet connection for:  
Hydrogen cyanide, anhydrous  
Phosgene, small valve series

Dimensions in inches unless otherwise specified.

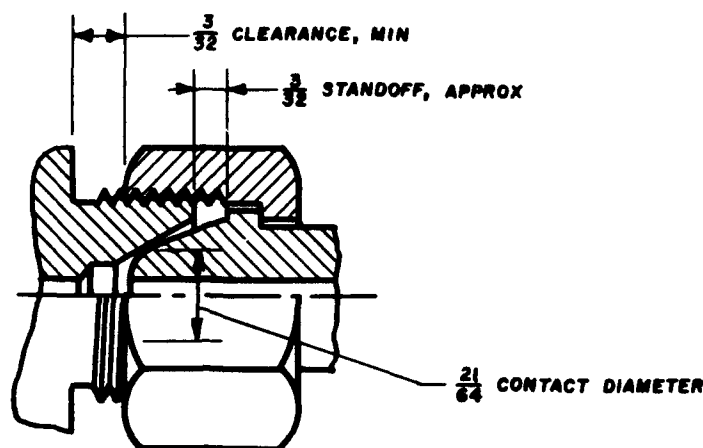
**FIGURE IX.2.—No. 160 valve outlet connection, 1/8-27NGT-RH-INT thread.**

4. ADAPTERS.—In the standardization of compressed gas valve outlet connections, more than one outlet is provided for some gases. To provide interchangeability of equipment for the same gas, adapters may be required.

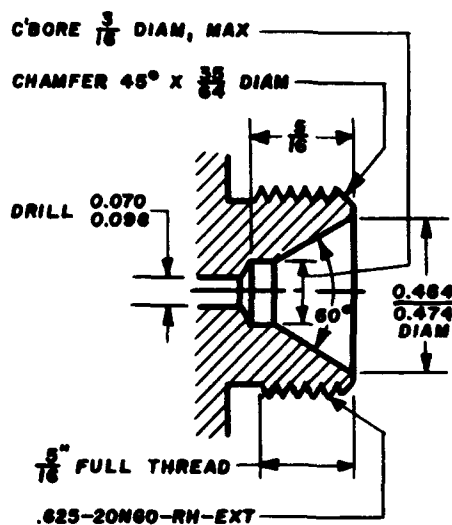
The appendix to ASA B57.1 (see footnote 7) lists detailed information on adapters which are designed to connect a cylinder valve outlet to a regulator, charging connection, or other mating part

having a different connection for the same gas. These adapters are limited to make the following connections (see footnote a, table IX.1.):

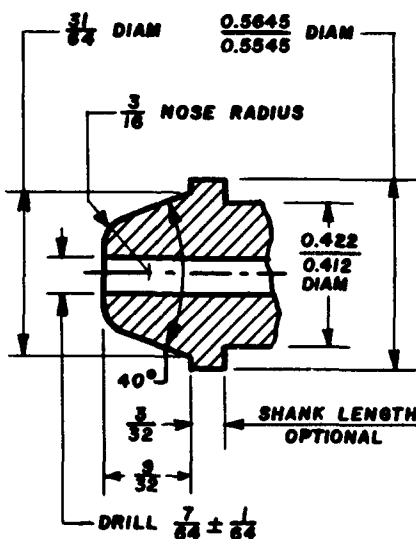
- (a) From standards to alternate standards for the same gas.
- (b) From alternate standards to standards for the same gas.
- (c) From one alternate standard to another alternate standard for the same gas.



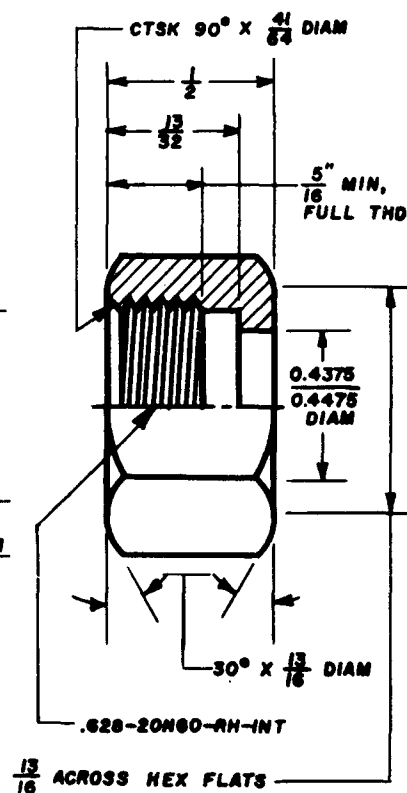
**CONNECTION NO. 200**



**VALVE OUTLET NO. 201**



**NIPPLE NO. 203**

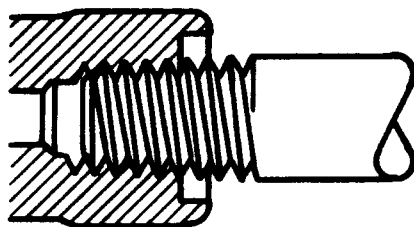


**HEX NUT NO. 204**

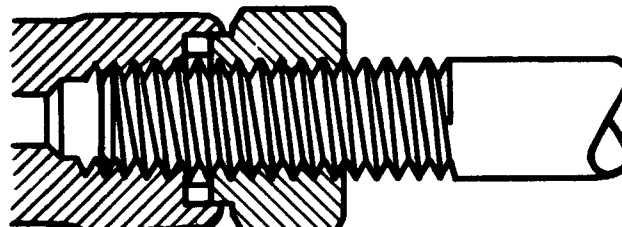
Standard outlet connection for: Acetylene, small valve series

Dimensions in inches unless otherwise specified.

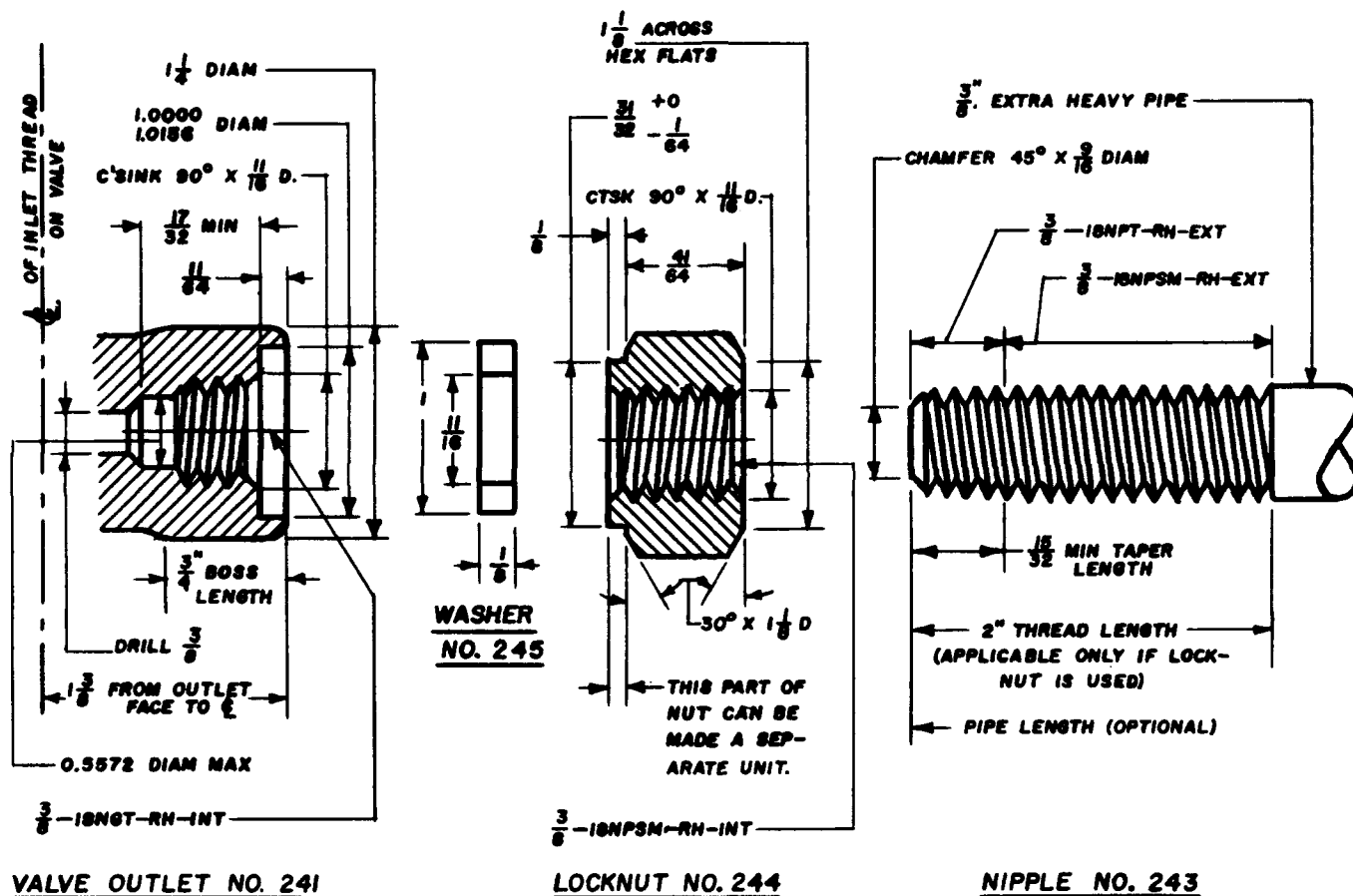
FIGURE IX.3.—No. 200 valve outlet connection, .625—20NG0—RH—EXT thread.



PLAIN PIPE CONNECTION



TYPICAL LOCKNUT CONNECTION



Dimensions for boss length and distance from outlet face to centerline of inlet thread on valve applicable only if right-angle outlet is used.

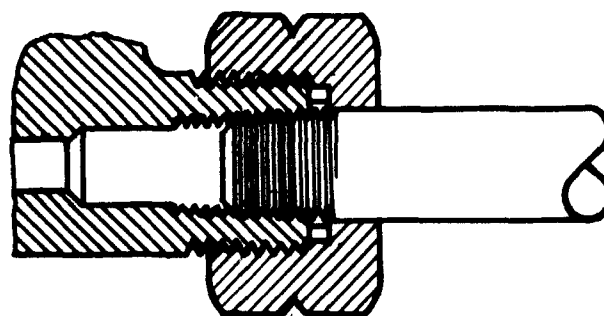
Standard outlet connection for:

Ammonia, anhydrous (co-standards 240 and 380 have been established for anhydrous ammonia. Connection No. 240 is standard for the Federal Services while No. 380 is the commercial standard.)

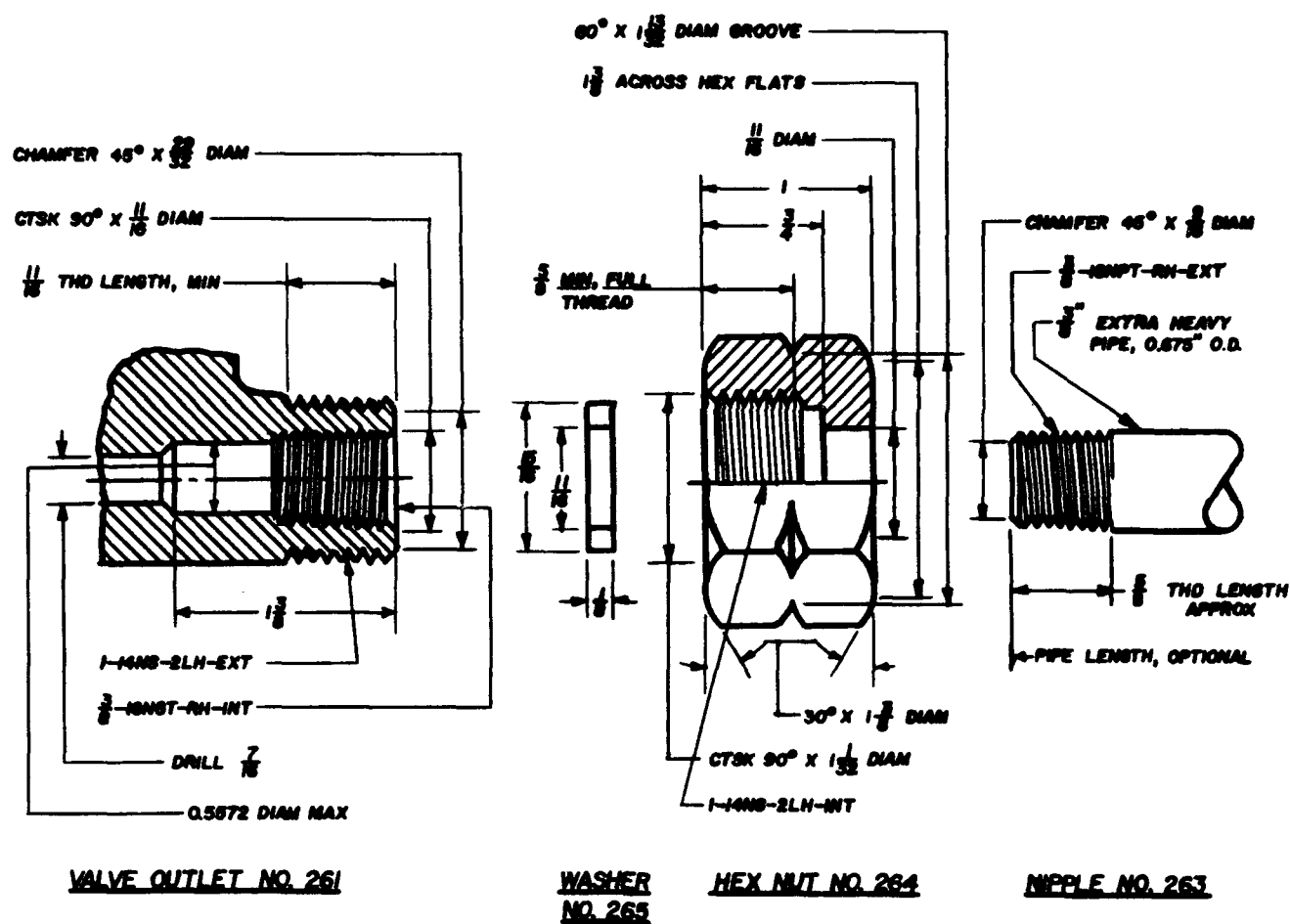
Dimethylamine, anhydrous  
Monomethylamine, anhydrous  
Trimethylamine, anhydrous

Dimensions in inches unless otherwise specified.

FIGURE IX.4.—No. 240 valve outlet connection, 3/8"-18NGT-RH-INT thread.



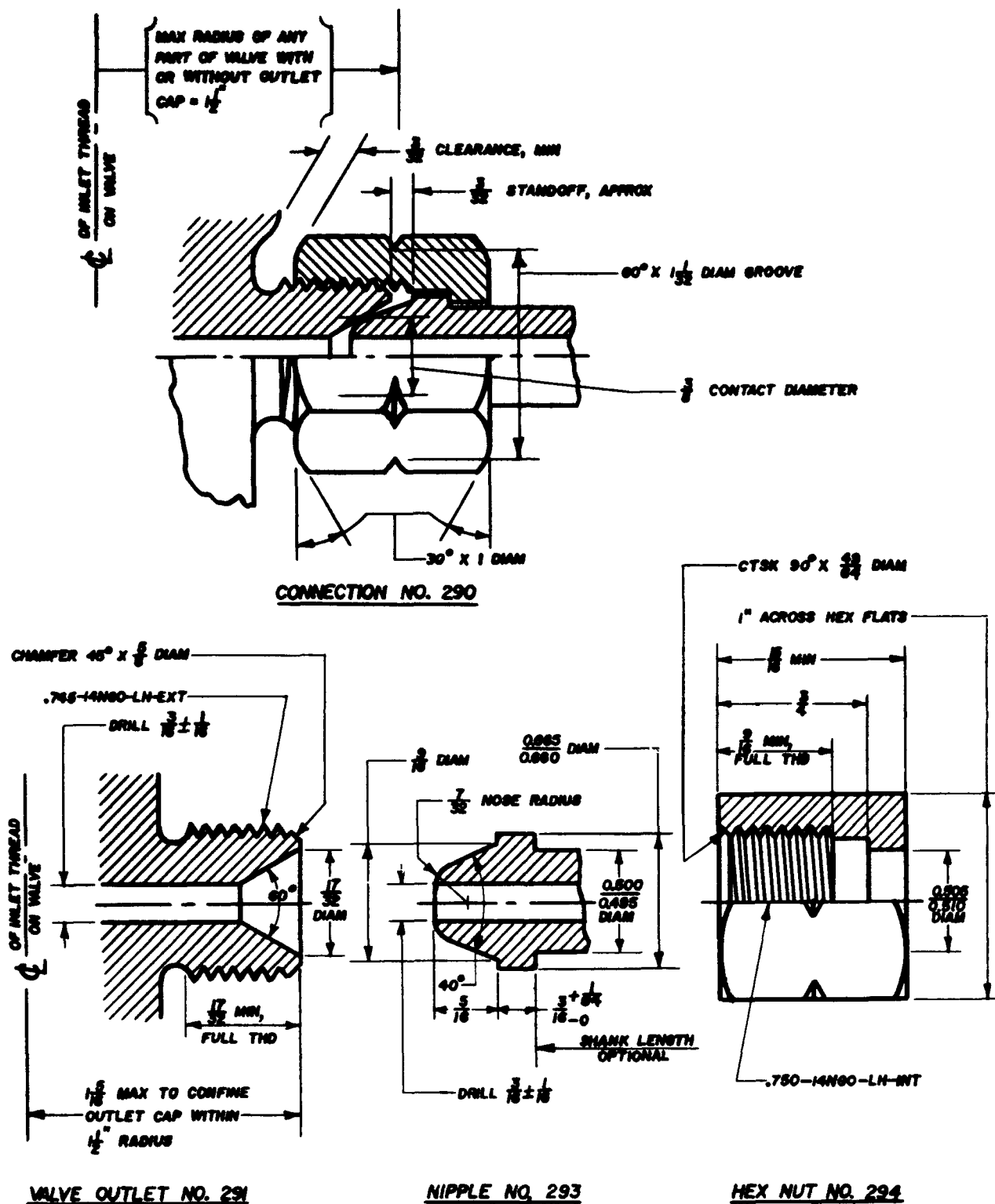
### CONNECTION NO. 260



Alternate Standard outlet connection for: Ammonia, anhydrous (see footnote a to table IX.1.)

Dimensions in inches unless otherwise specified.

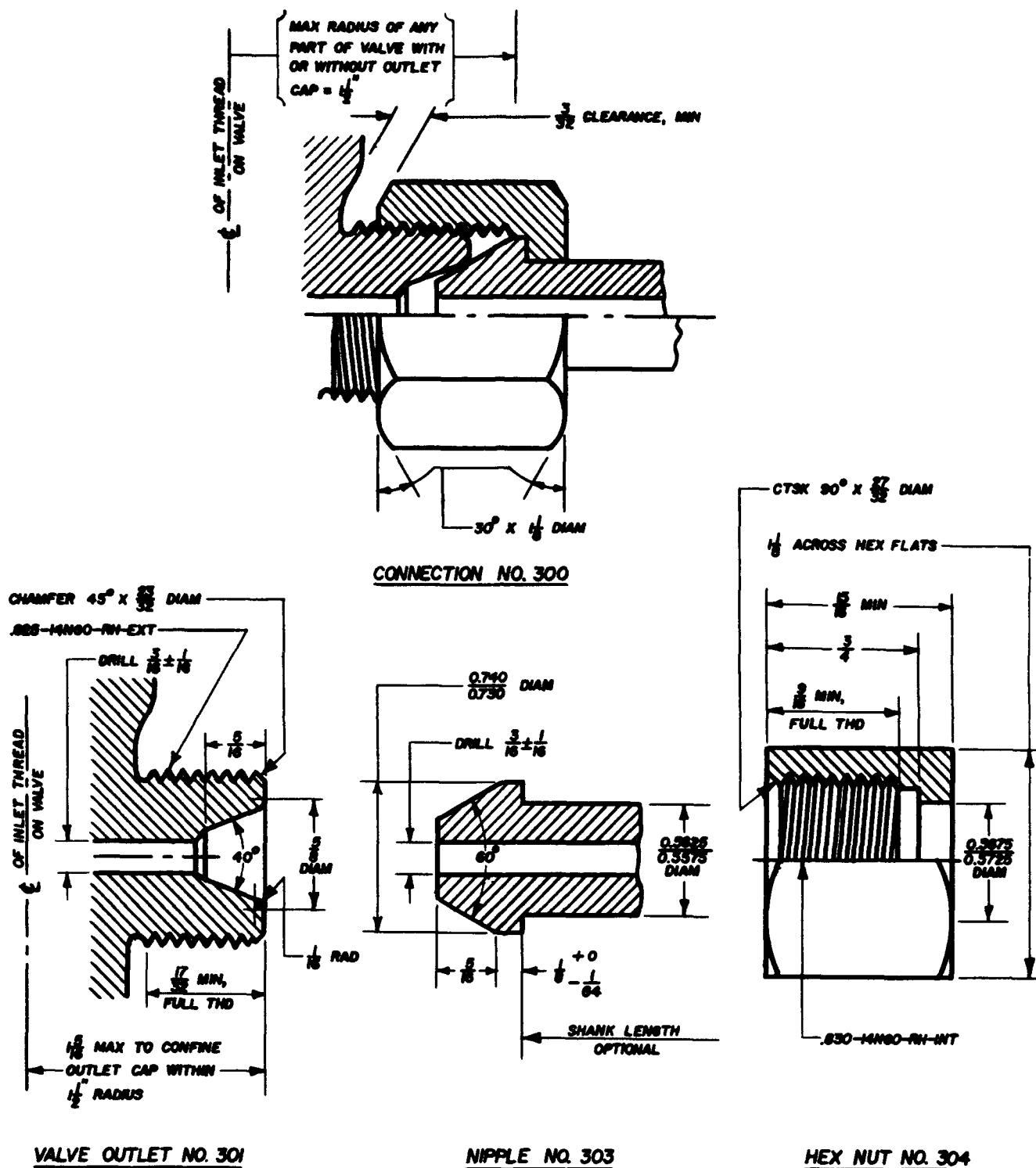
FIGURE IX.5.—No. 260 valve outlet connection,  $\frac{3}{8}-18NST-RH-INT$  thread with nut with  $1-14NS-2LH-INT$  thread.



Standard outlet connection for:  
 Vinyl chloride, inhibited  
 Vinyl methyl ether, inhibited

Dimensions in inches unless otherwise specified.

FIGURE IX.6.—No. 290 valve outlet connection, .745—14NGO—LH—EXT thread.

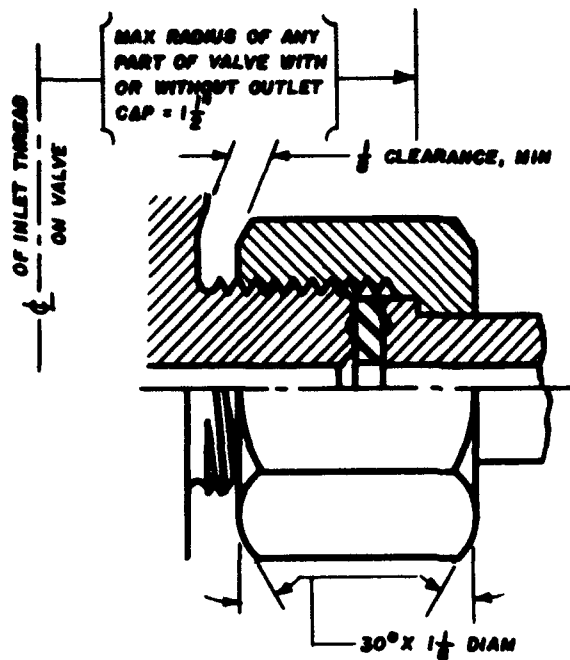


Standard outlet connection for: Ethyl chloride  
 Alternate standard outlet connection for: \*  
 Acetylene  
 Butane (No. 2 alternate)  
 Propane (No. 2 alternate)

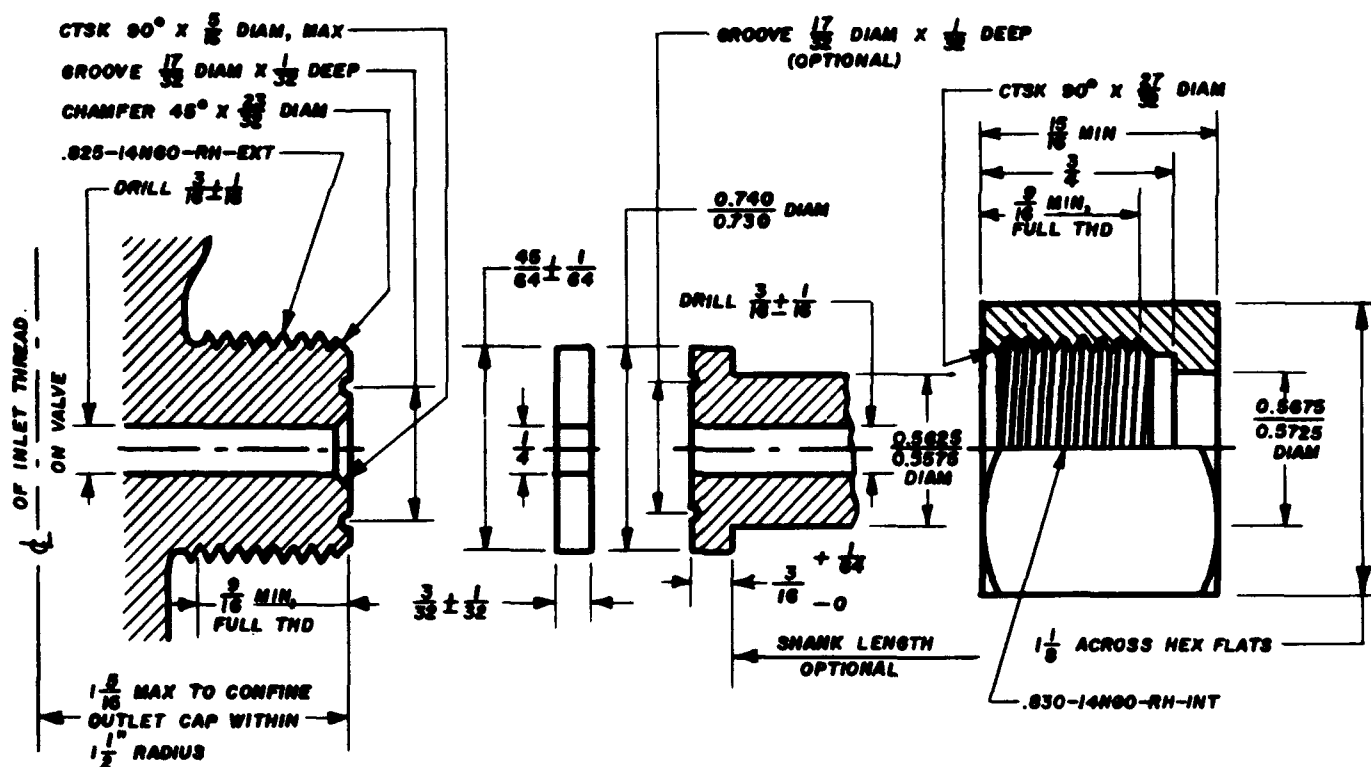
Dimensions in inches unless otherwise specified.

FIGURE IX.7.—No. 300 valve outlet connection, .825-14NGO-RH-EXT thread with conical nipple.

\* See footnote a to table IX.1.



**CONNECTION NO. 320**



**VALVE OUTLET NO. 321**

**WASHER  
NO. 325**

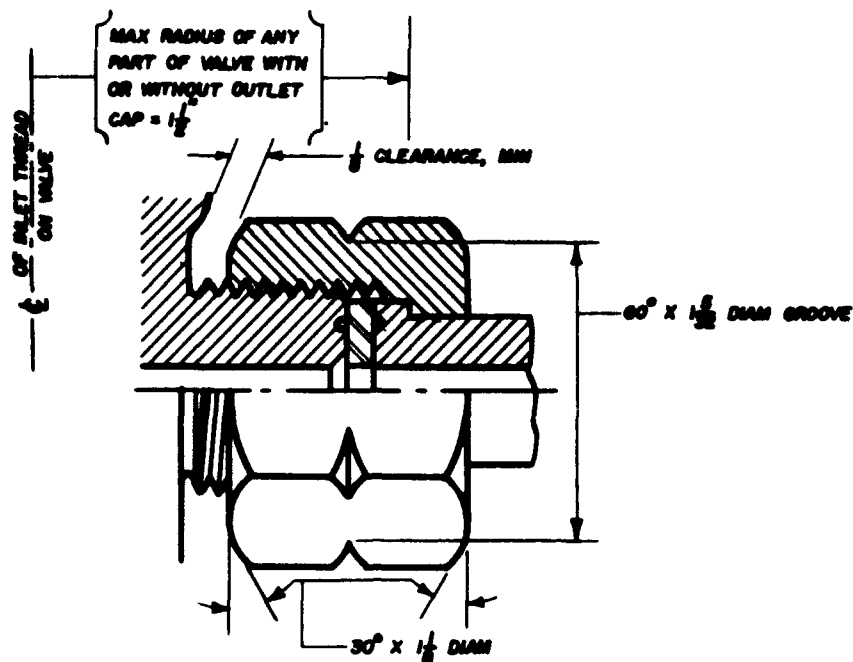
**NIPPLE NO. 323**

**HEX NUT NO. 324**

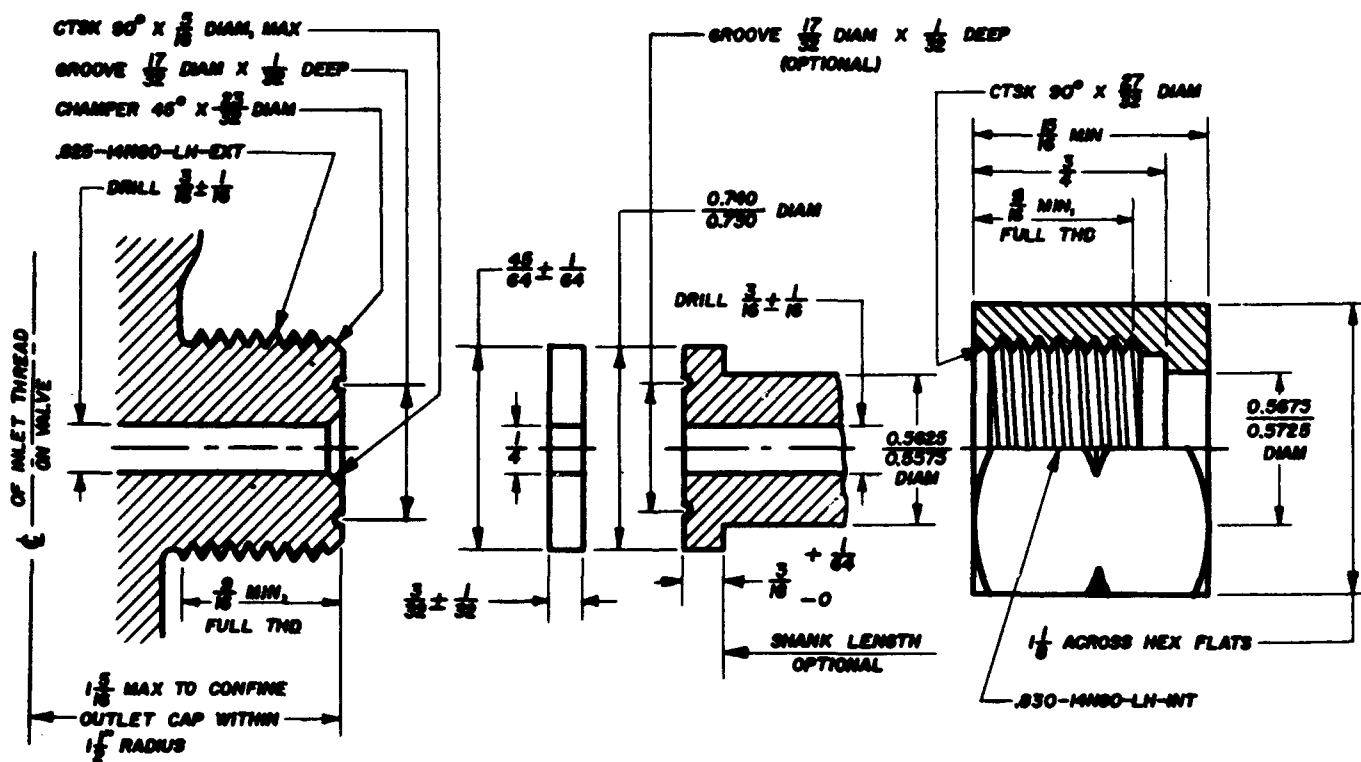
Standard outlet connection for:  
Carbon dioxide  
Nitrous oxide

Dimensions in inches unless otherwise specified.

FIGURE IX.8.—No. 320 valve outlet connection, .825—14NGO—RH—EXT thread with flat nipple.



**CONNECTION NO. 330**



**VALVE OUTLET NO. 331**

**WASHER  
NO. 335**

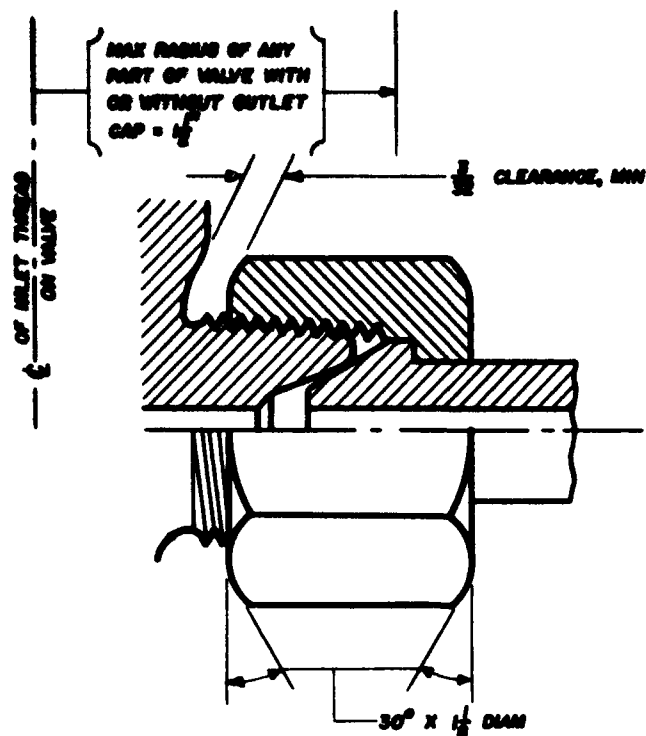
**NIPPLE NO. 333**

**HEX NUT NO. 334**

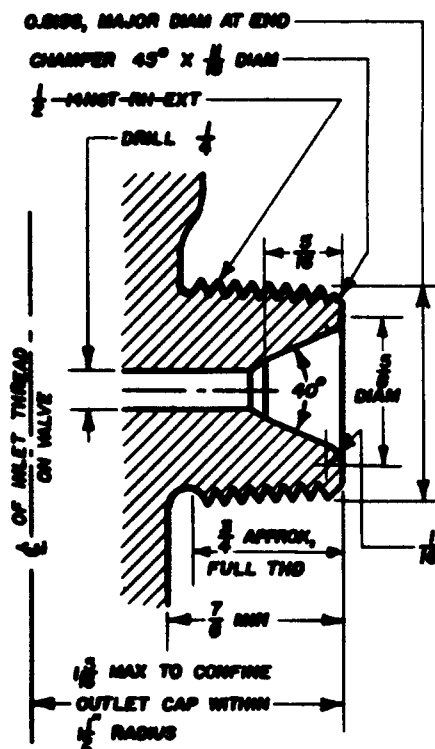
Standard outlet connection for:  
Boron trifluoride  
Hydrogen chloride, anhydrous  
Hydrogen sulphide  
Methyl mercaptan

Dimensions in inches unless otherwise specified.

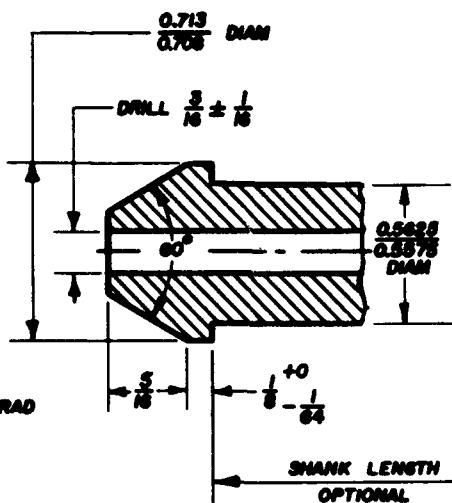
**FIGURE IX.9.—No. 330 valve outlet connection, .825-14NGO-LH-EXT thread with flat nipple.**



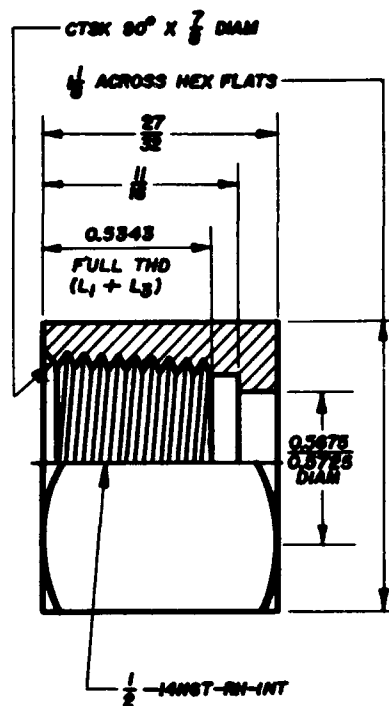
**CONNECTION NO. 340**



**VALVE OUTLET NO. 341**



**NIPPLE NO. 343**

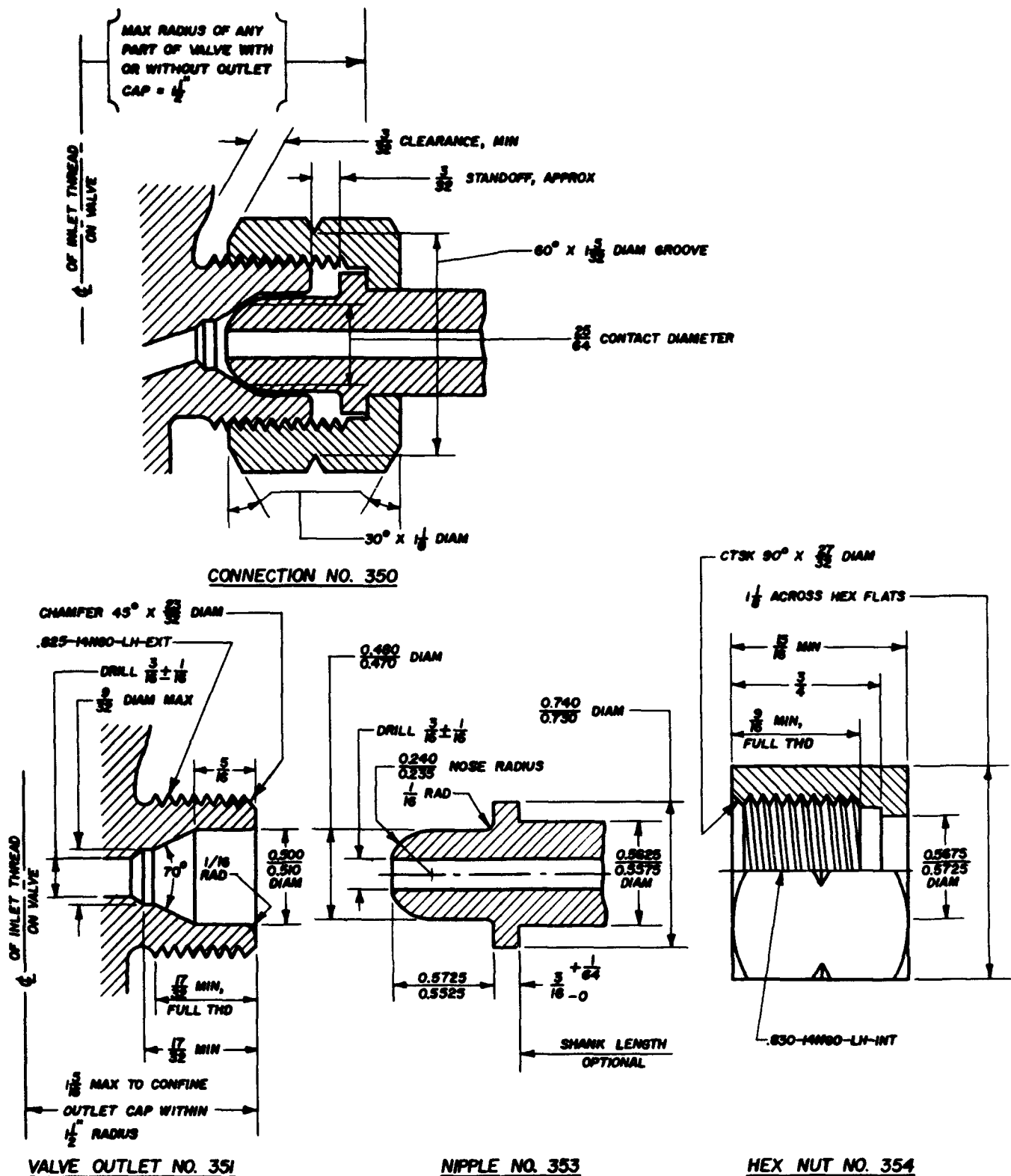


**HEX NUT NO. 344**

Alternate standard outlet connection for: Methyl bromide (see footnote a to table IX.1.)

Dimensions in inches unless otherwise specified.

**FIGURE IX.10.—No. 340 valve outlet connection,  $\frac{1}{2}$ —14NGT-RH-EXT thread with conical nipple.**



Standard outlet connection for:  
 Carbon dioxide-ethylene oxide mixtures  
 Carbon monoxide  
 Ethylene, industrial and medical

Ethane  
 Hydrogen  
 Methane

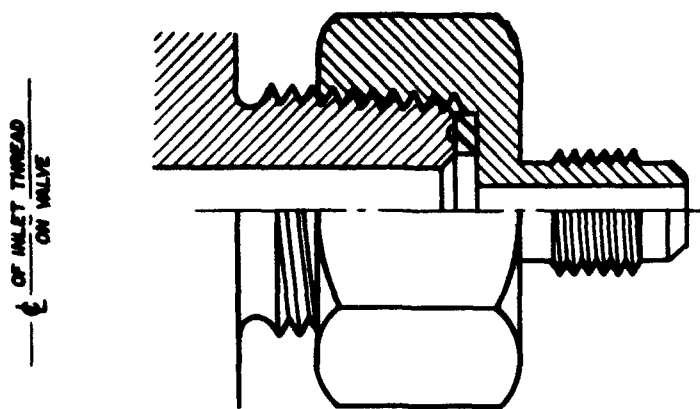
Alternate standard outlet connection \* for:  
 Butane (No. 1 alternate)  
 Ethylene oxide  
 Helium, oil-pumped

Isobutane  
 Propane (No. 1 alternate)  
 Propylene

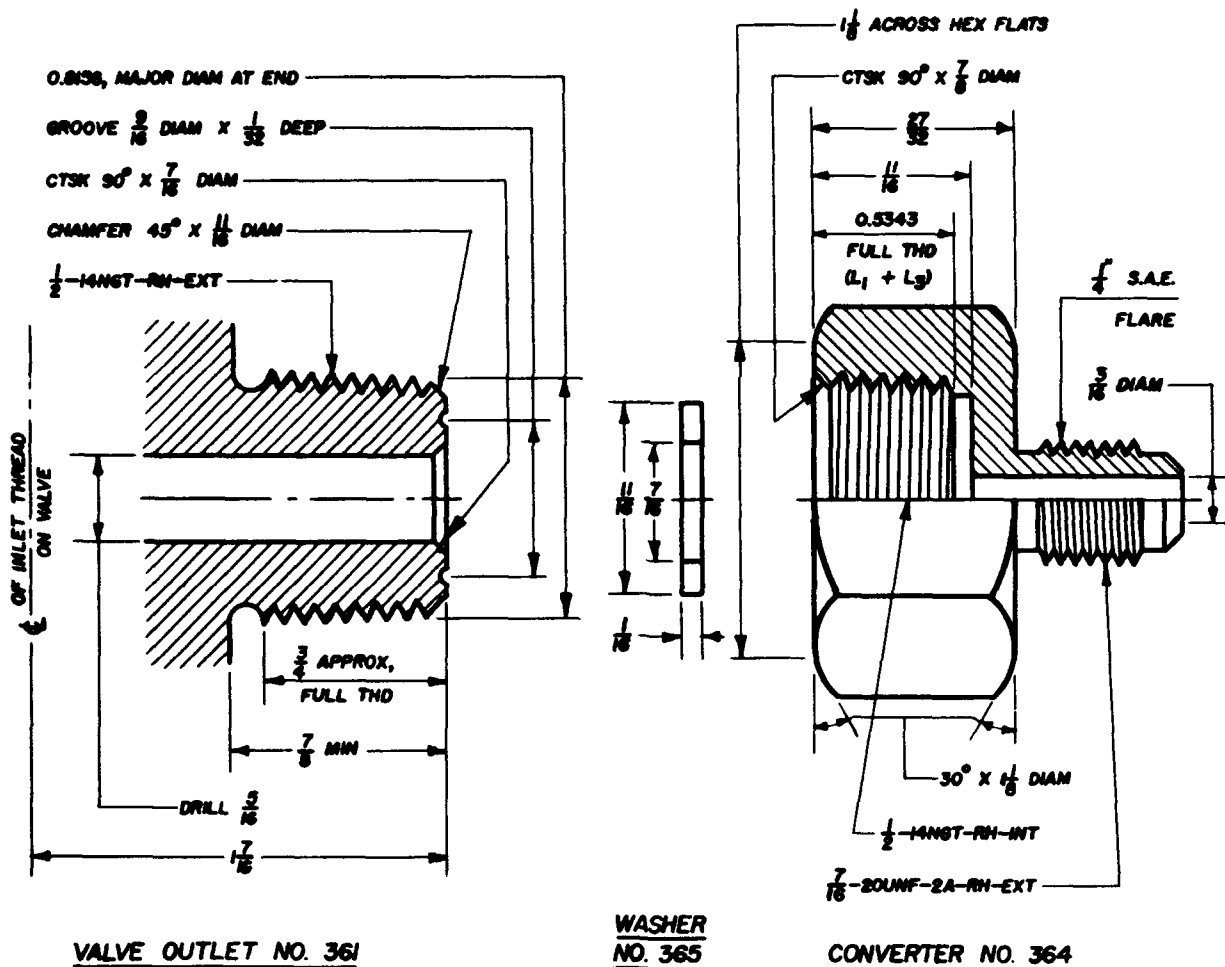
Dimensions in inches unless otherwise specified.

FIGURE IX.11.—No. 350 valve outlet connection, .825—14NGO-LH-EXT thread with round nipple.

\* See footnote a to table IX.1.



CONNECTION NO. 360

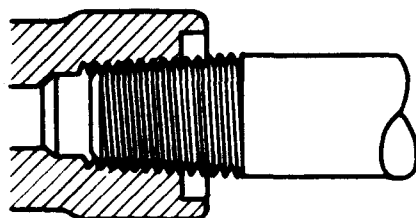


Alternate standard outlet connection \* for:  
Methyl chloride  
Sulphur dioxide

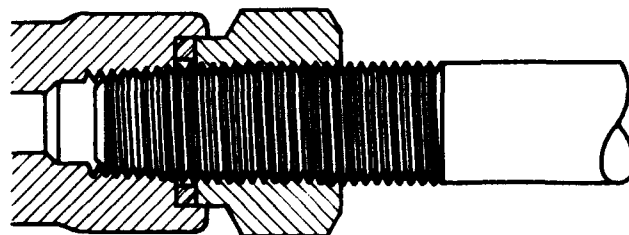
Dimensions in inches unless otherwise specified.

FIGURE IX.12.—No. 360 valve outlet connection,  $\frac{1}{2}$ -14NGT-RH-EXT thread.

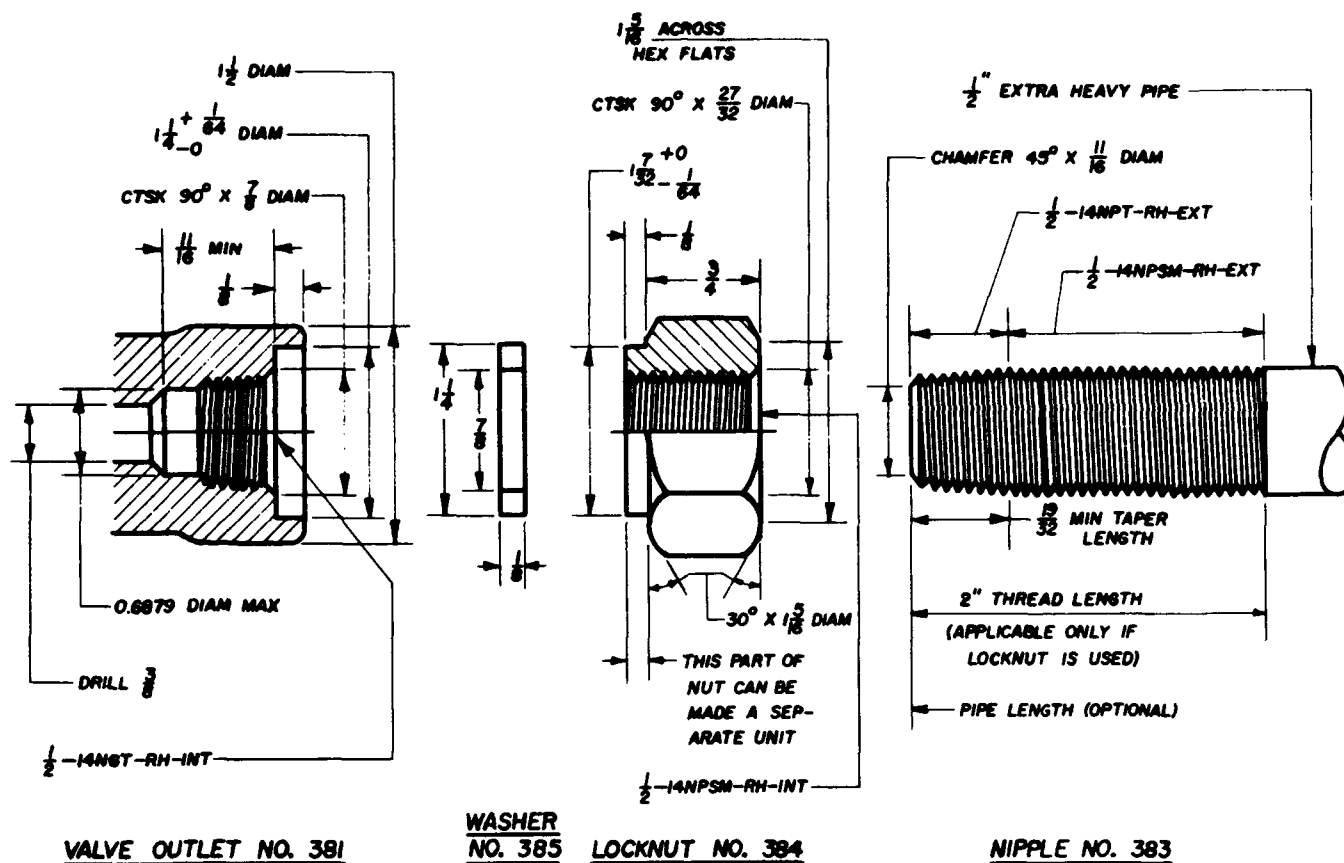
\* See footnote a to table IX.1.



PLAIN PIPE CONNECTION



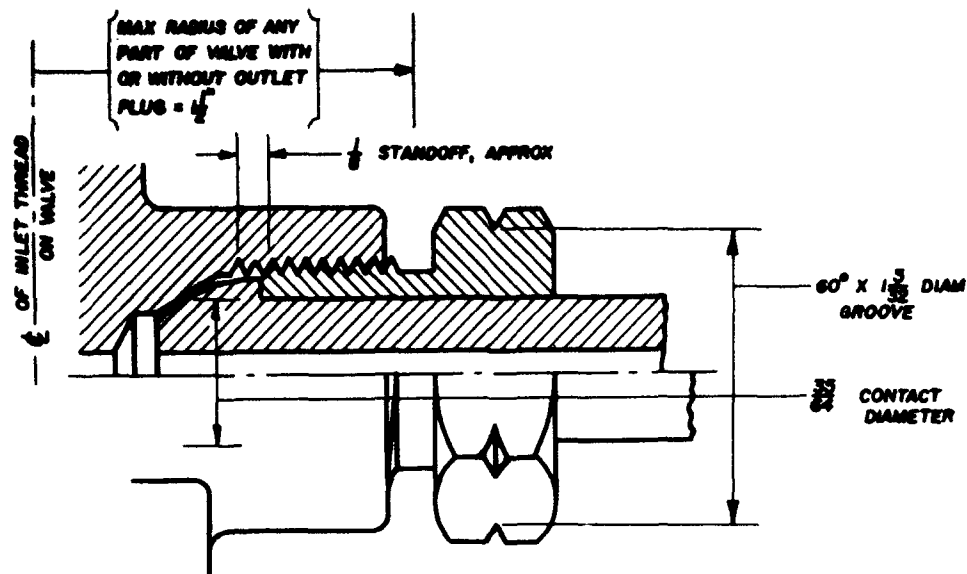
TYPICAL LOCKNUT CONNECTION



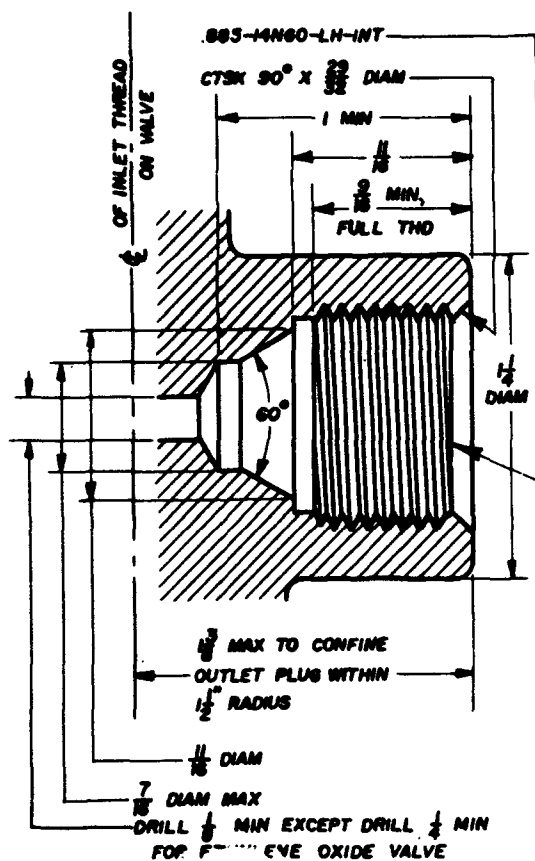
Standard outlet connection for:  
Ammonia, anhydrous (co-standards 240 and 380 have been established for anhydrous ammonia. Connection No. 240 is standard for the Federal Services while No. 380 is the commercial standard).

Dimensions in inches unless otherwise specified.

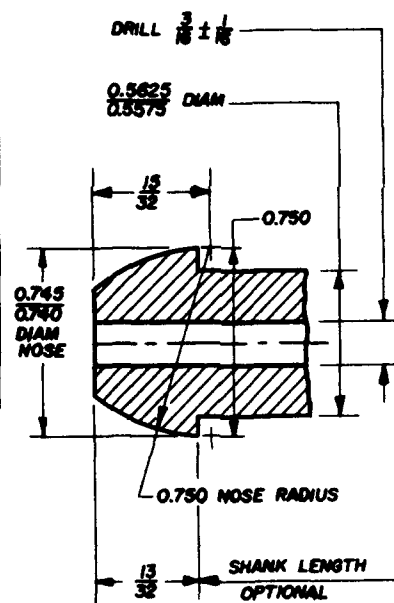
FIGURE IX.13.—No. 380 valve outlet connection, 1/2-14NGT-RH-INT thread.



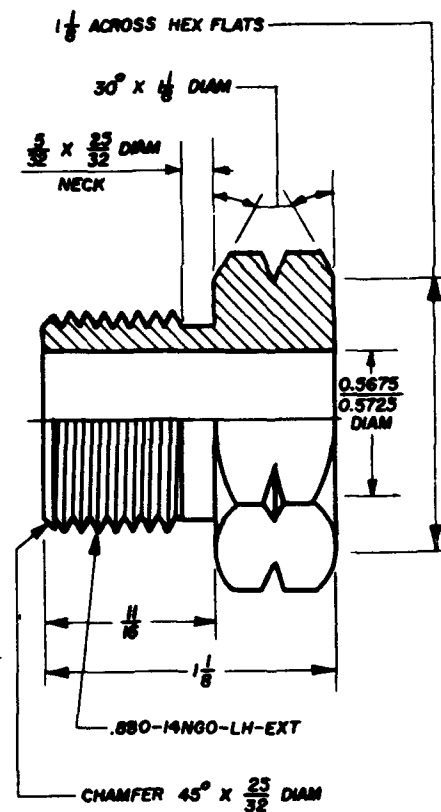
CONNECTION NO. 510



VALVE NO. 511



NIPPLE NO. 513

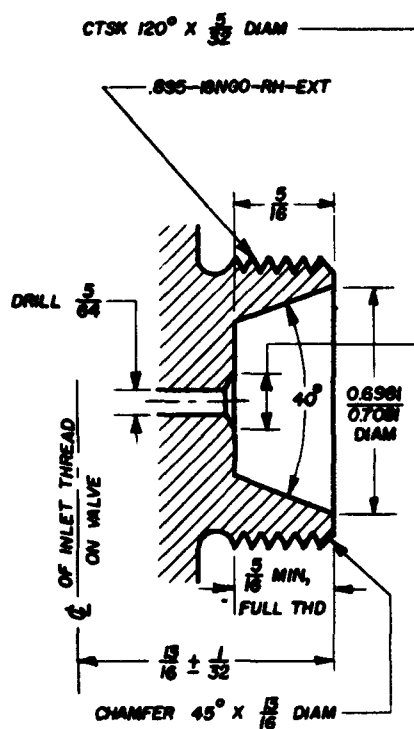
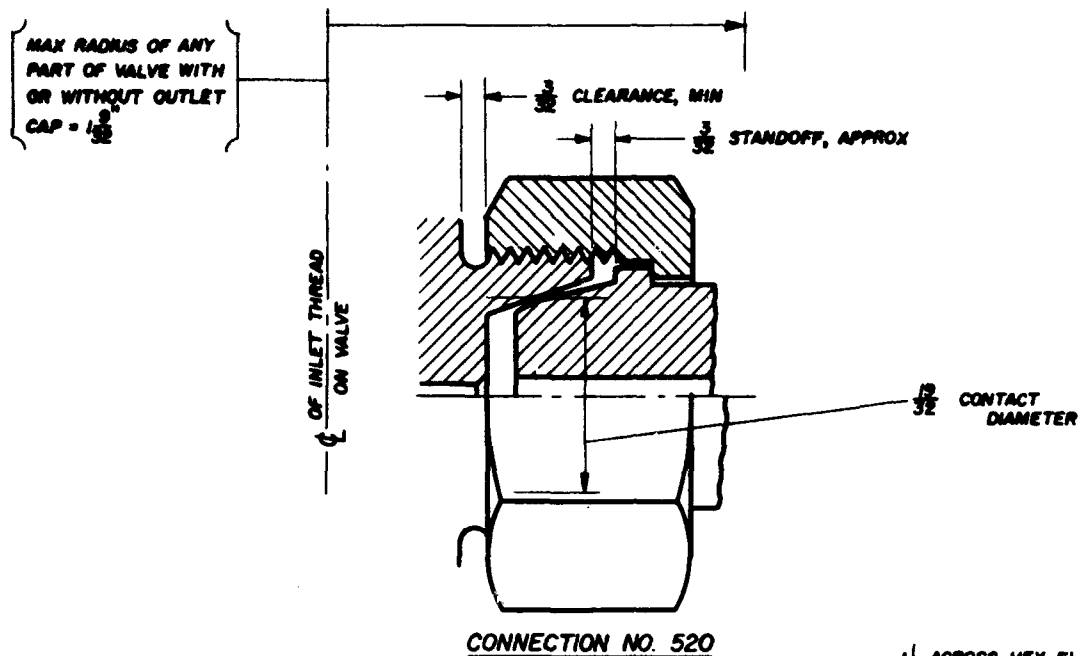


HEX NUT NO. 514

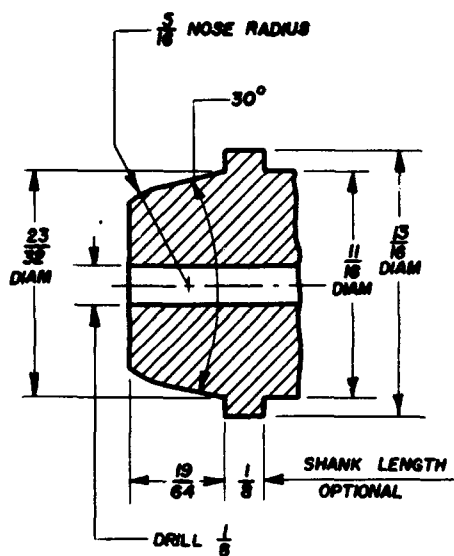
Standard outlet connection for:  
 Acetylene    Cyclopropane, industrial    Isobutane  
 Butadiene    Dimethyl ether    Propane  
 Butane    Ethylene oxide    Propylene

Dimensions in inches unless otherwise specified.

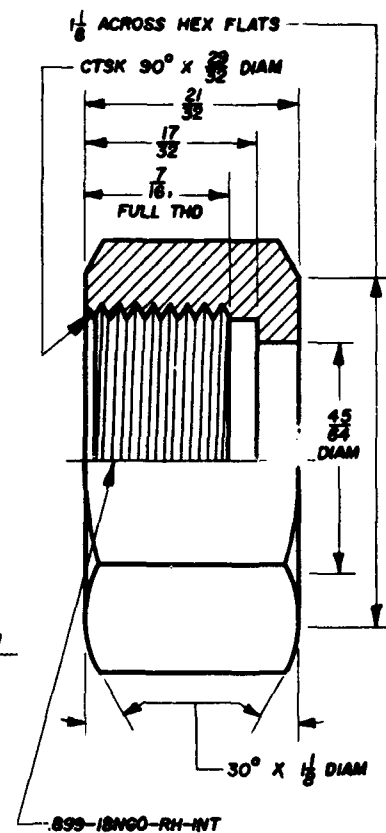
FIGURE IX.14.—No. 510 valve outlet connection, .885-14NG0-LH-INT thread.



**VALVE OUTLET NO. 521**



**NIPPLE NO. 523**

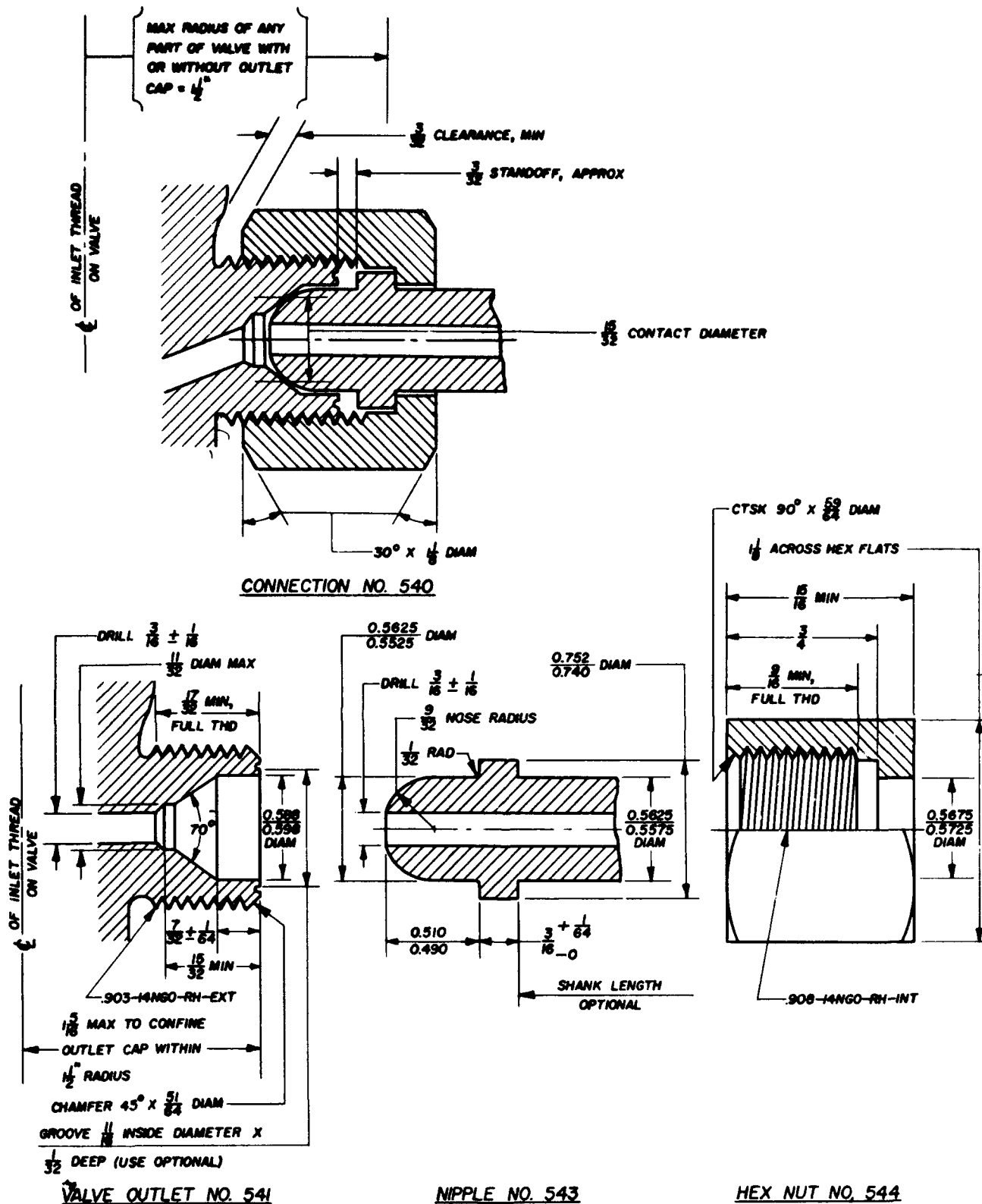


**HEX NUT NO. 524**

Alternate standard outlet connection for: Acetylene, small valve series (see footnote a to table IX.1.)

Dimensions in inches unless otherwise specified.

FIGURE IX.15.—No. 520 valve outlet connection, .895-18NGO-RH-EXT thread.

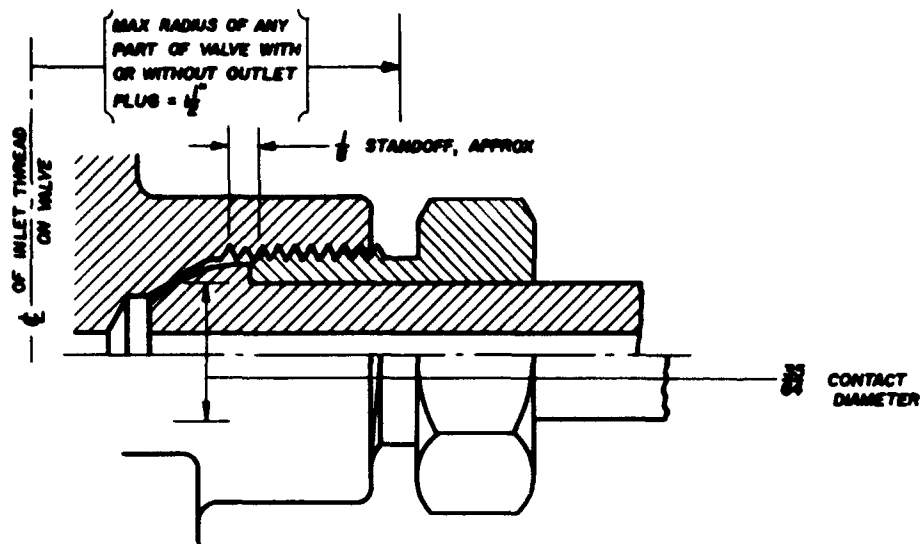


Standard outlet connection for: Oxygen, Industrial and medical

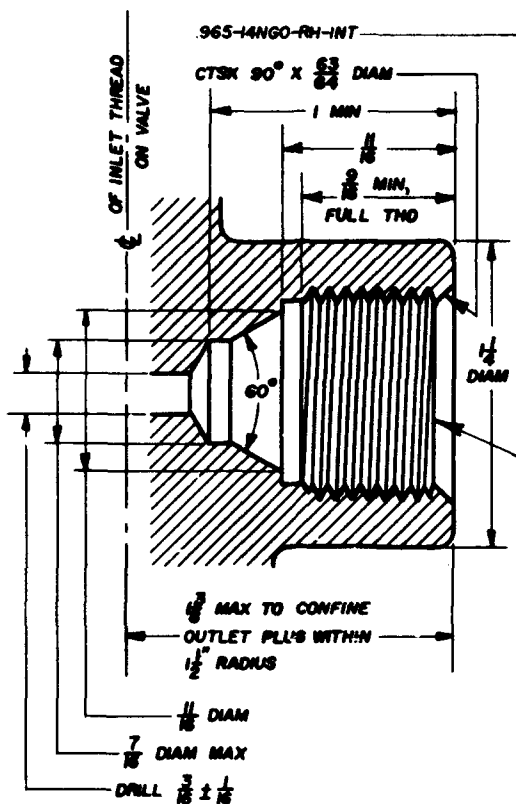
Dimensions in inches unless otherwise specified.

WARNING: DO NOT USE THIS CONNECTION FOR ANY OTHER GAS OR FOR ANY GAS MIXTURE.

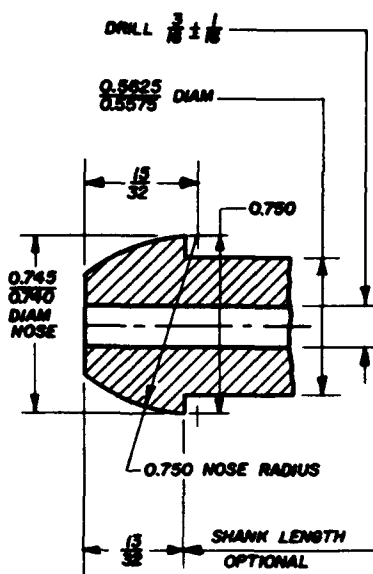
FIGURE IX.16.—No. 540 valve outlet connection, .903—14NGO—RH—EXT thread with round nipple.



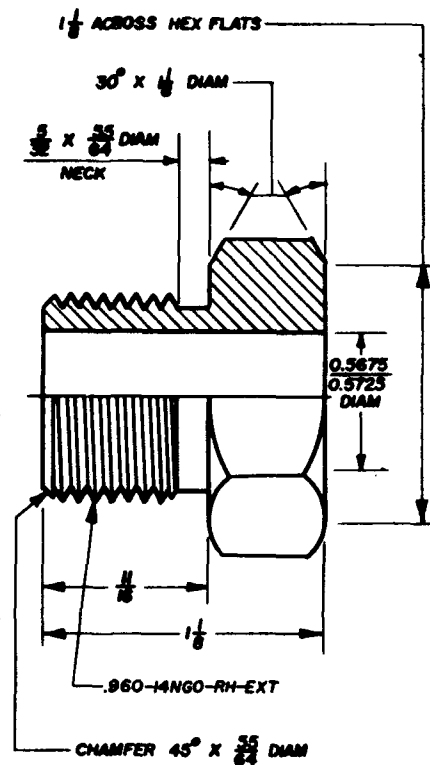
CONNECTION NO. 580



VALVE OUTLET NO. 581



NIPPLE NO. 583

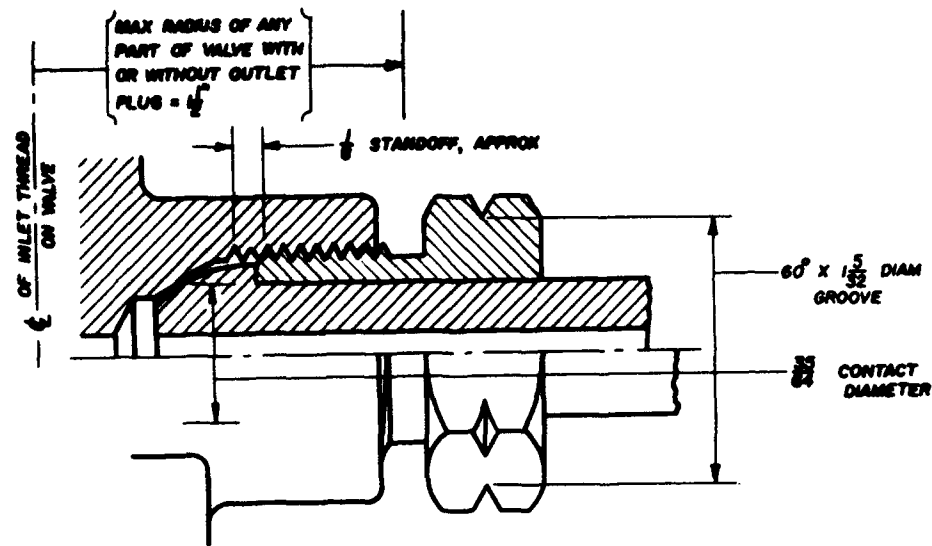


HEX NUT NO. 584

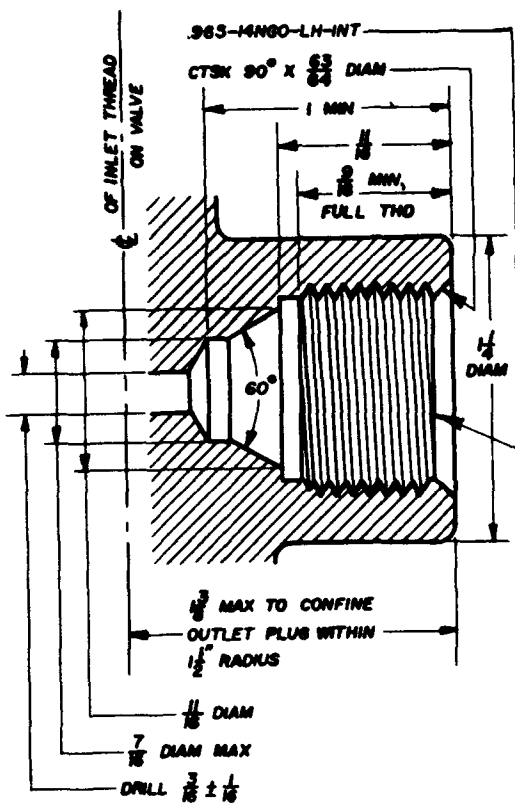
Standard outlet connection for:  
 Air, water-pumped      Neon, water-pumped  
 Argon, water-pumped    Nitrogen, water-pumped  
 Helium, water-pumped    Xenon, water-pumped  
 Krypton, water-pumped

Dimensions in inches unless otherwise specified.

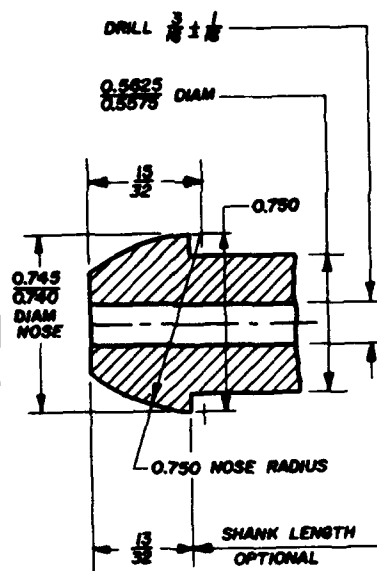
FIGURE IX.17.—No. 580 valve outlet connection, .965-14NGO-RH-INT thread.



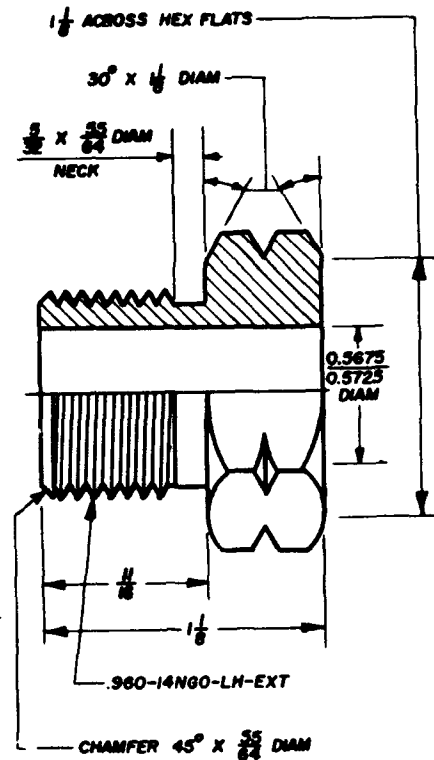
CONNECTION NO. 590



VALVE OUTLET NO. 591



NIPPLE NO. 593

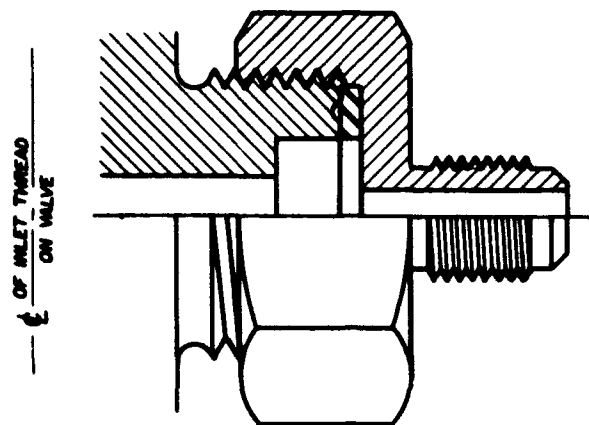


HEX NUT NO. 594

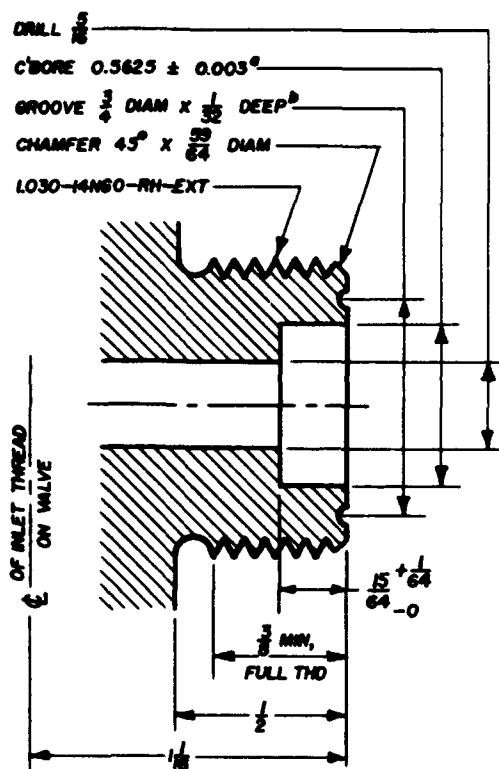
Standard outlet connection for:  
 Air, oil-pumped      Neon, oil-pumped  
 Argon, oil-pumped    Nitrogen, oil-pumped  
 Helium, oil-pumped    Sulphur hexafluoride  
 Krypton, oil-pumped   Xenon, oil-pumped

Dimensions in inches unless otherwise specified.

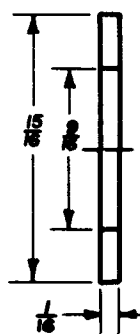
FIGURE IX.18.—No. 590 valve outlet connection, .965-14NGO-LH-INT thread.



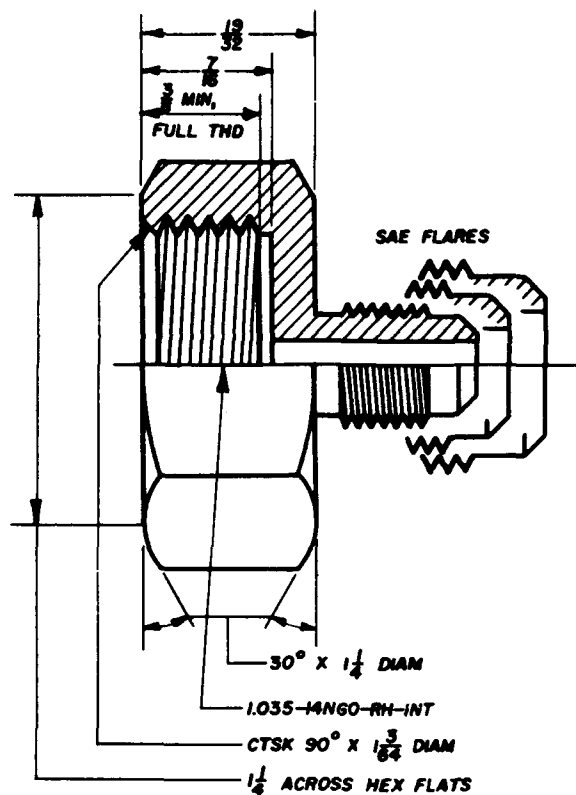
CONNECTION NO. 620



VALVE OUTLET NO. 621



WASHER  
NO. 625



CONVERTER NO. 624

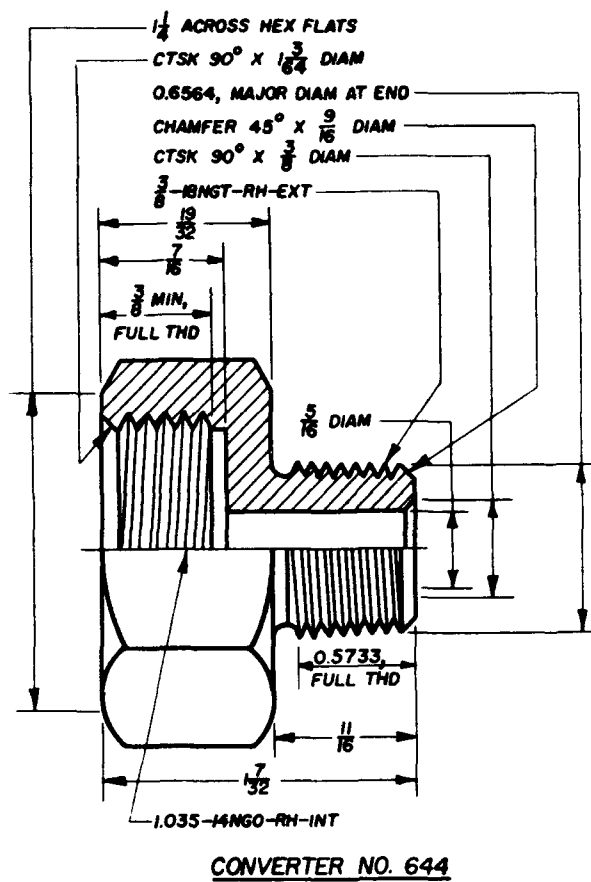
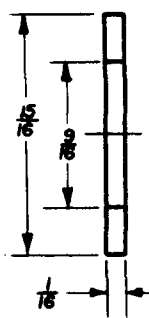
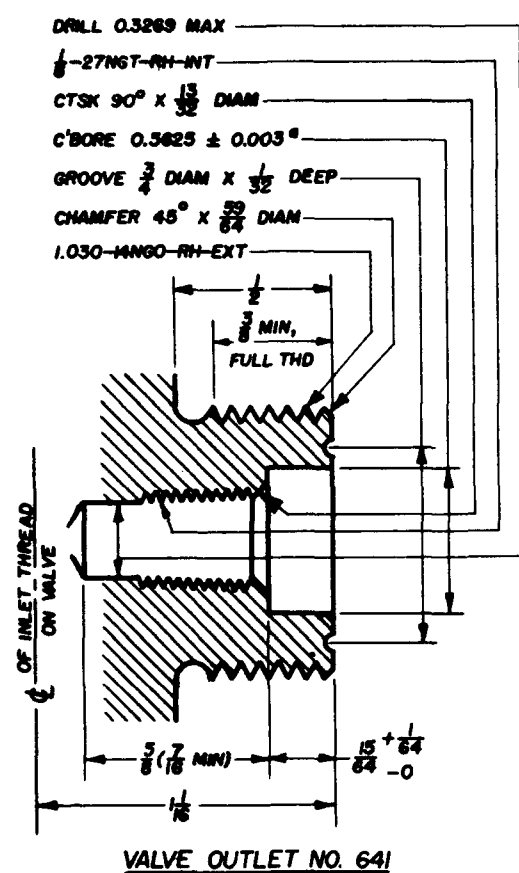
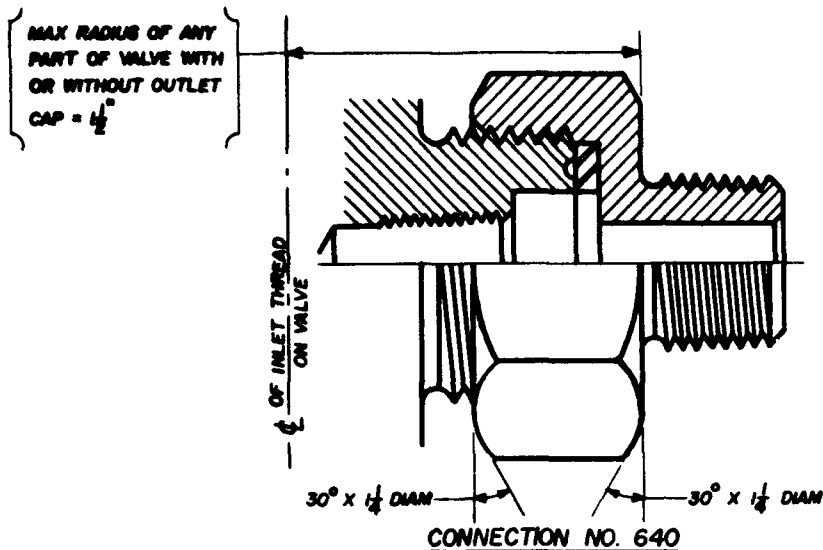
- \* Counterbore may be omitted when so specified.  
 \* If groove is not required, use valve outlet No. 661, figure IX.21.

Standard outlet connection for:  
 Bromochloromethane  
 Dichlorodifluoromethane  
 Dichlorodifluoromethane-difluoroethane mixture  
 Difluorodibromoethane  
 Methyl bromide  
 Methyl chloride

Monochlorodifluoromethane  
 Monochlorotetrafluoroethane  
 Monochlorotrifluoromethane  
 Sulphur dioxide  
 Tetrafluoroethylene  
 Trifluorobromomethane  
 Trifluorochloroethylene, inhibited

Dimensions in inches unless otherwise specified.

FIGURE IX.19.—No. 620 valve outlet connection, 1.030-14NG0-RH-EXT thread with flare converters.

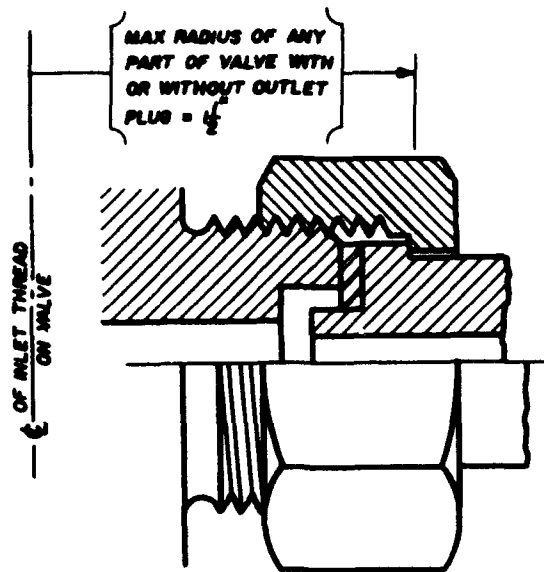


\* Counterbore may be omitted when so specified.

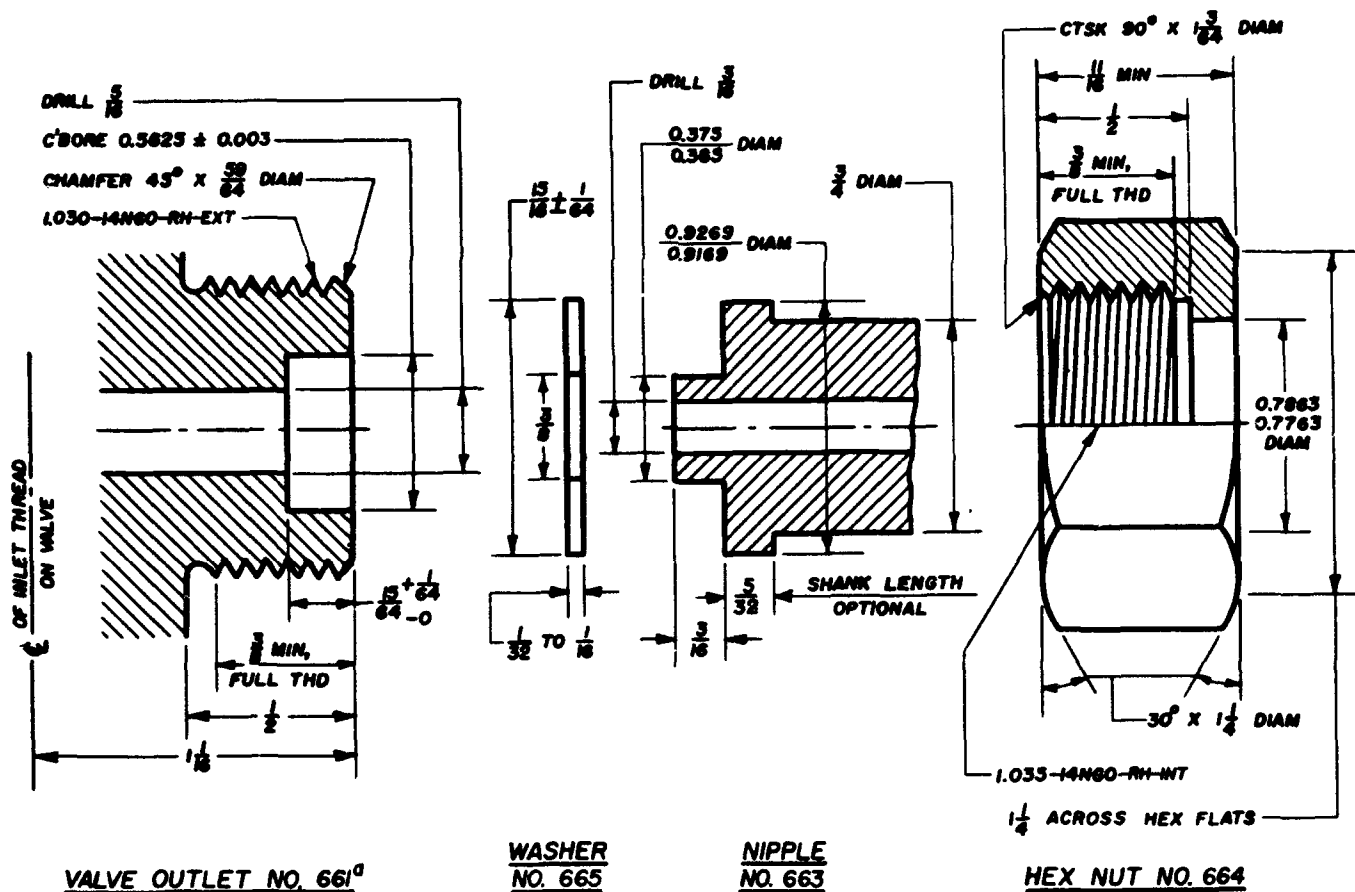
Standard outlet connection for: Phosgene

Dimensions in inches unless otherwise specified.

FIGURE IX.20.—No. 640 valve outlet connection, 1.030-14NGO-RH-EXT thread with  $\frac{3}{8}$ -18NGT-RH-EXT converter.



**CONNECTION NO. 660**

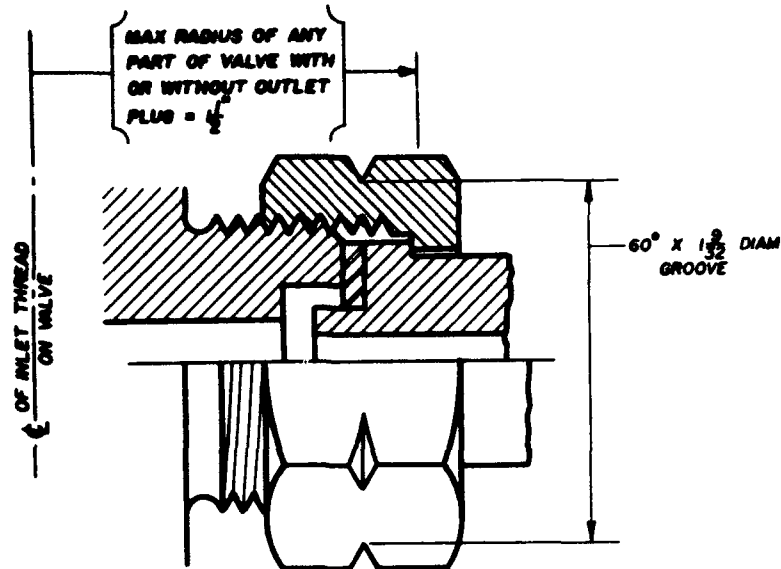


<sup>a</sup> If groove is required, use valve outlet No. 621, figure IX.19.

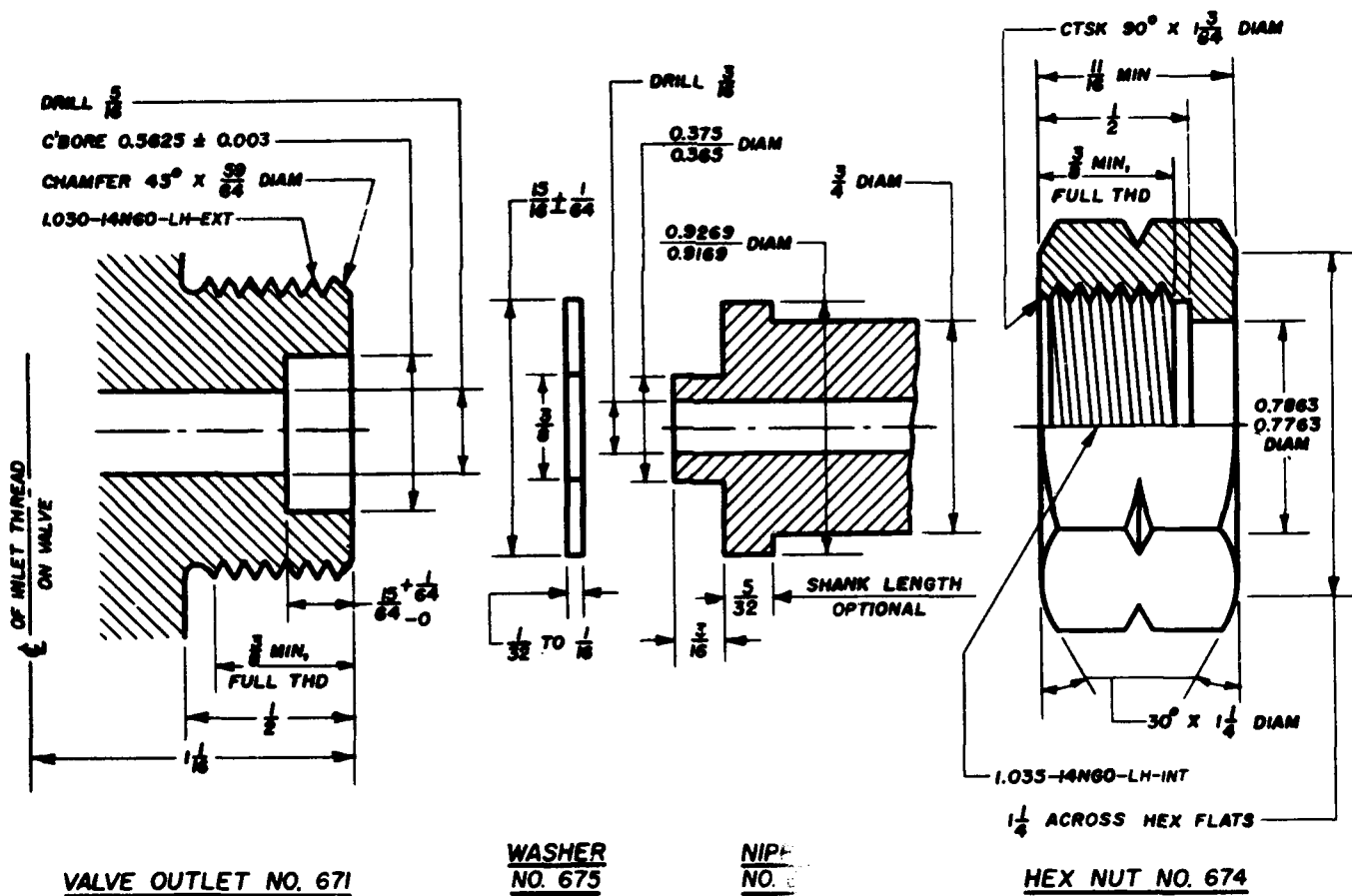
Standard outlet connection for:  
Chlorine  
Difluoroethane  
Difluoromonoethane

Dimensions in inches unless otherwise specified.

FIGURE IX.21.—No. 660 valve outlet connection, 1.030-14NG0-RH-EXT thread with nut and nipple.



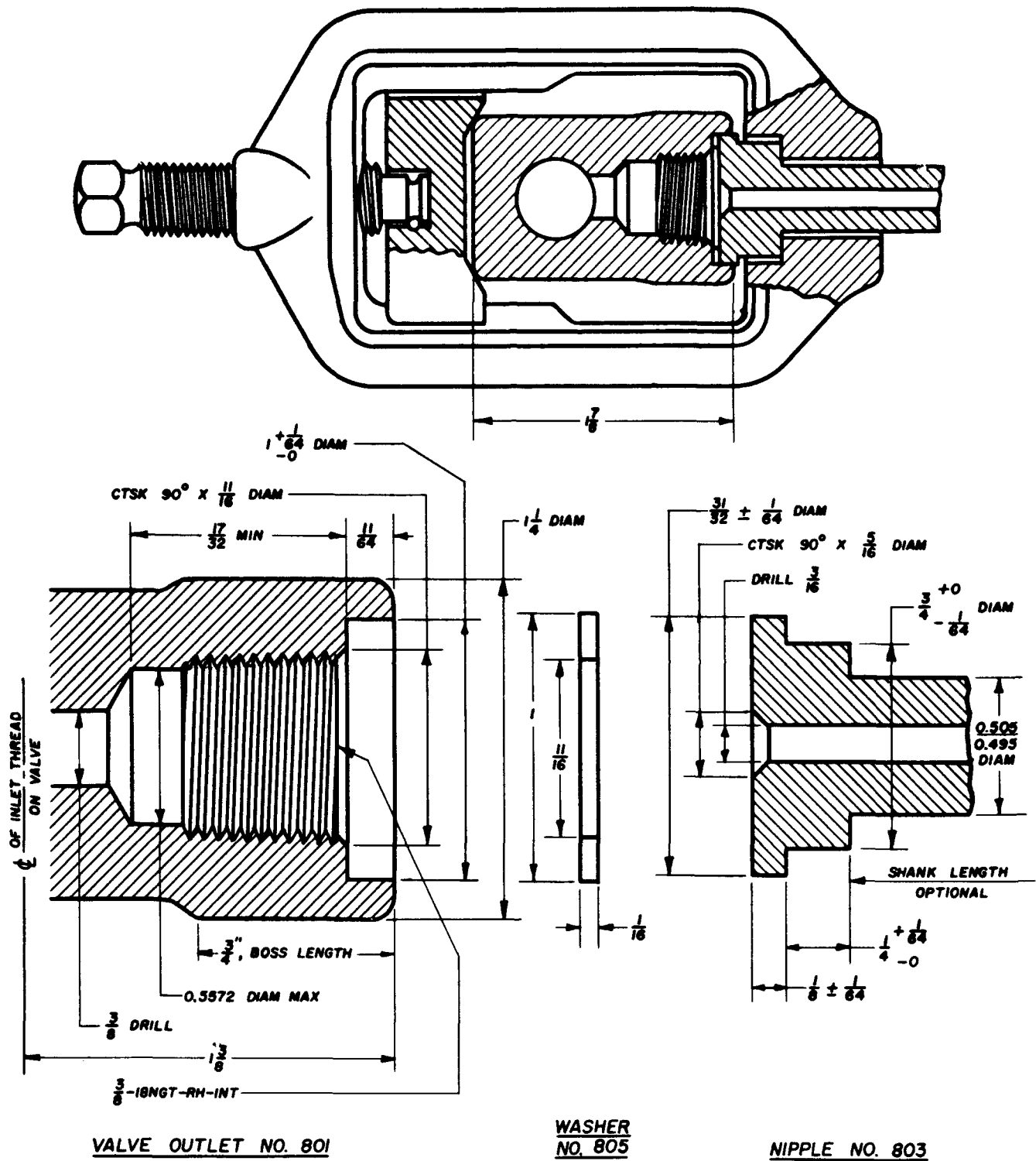
**CONNECTION NO. 670**



Standard outlet connection for:  
Chlorine trifluoride  
Fluorine  
Hydrogen fluoride, anhydrous

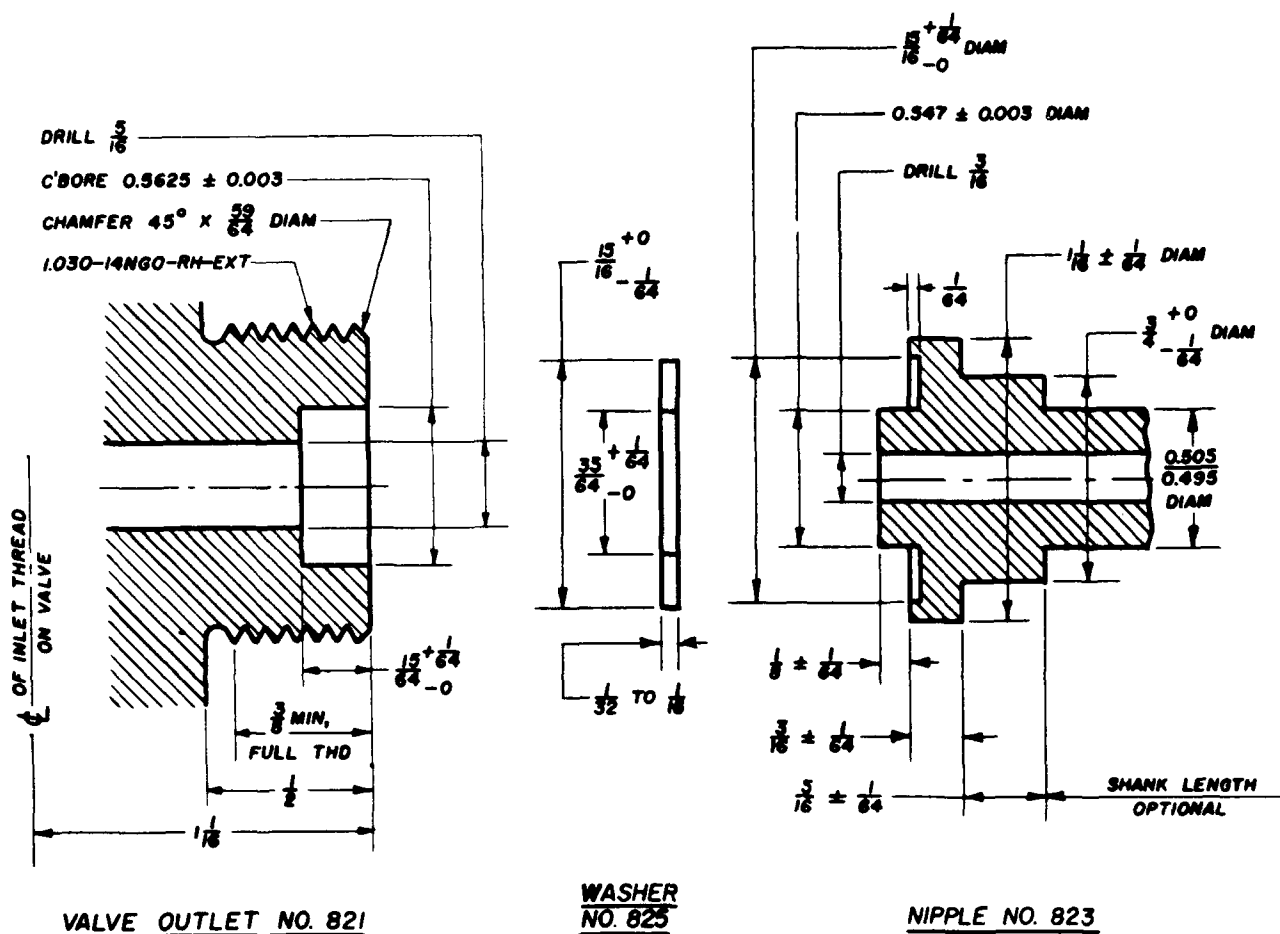
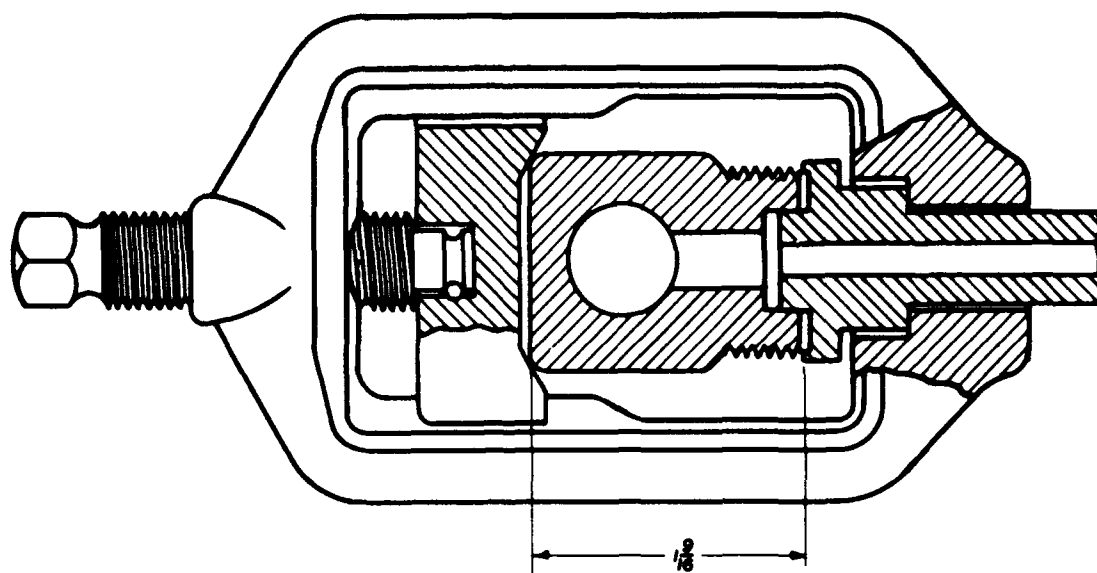
Dimensions in inches unless otherwise specified.

FIGURE 1X.22.—No. 670 valve outlet connection, 1.030-14NG0-LH-EXT thread.



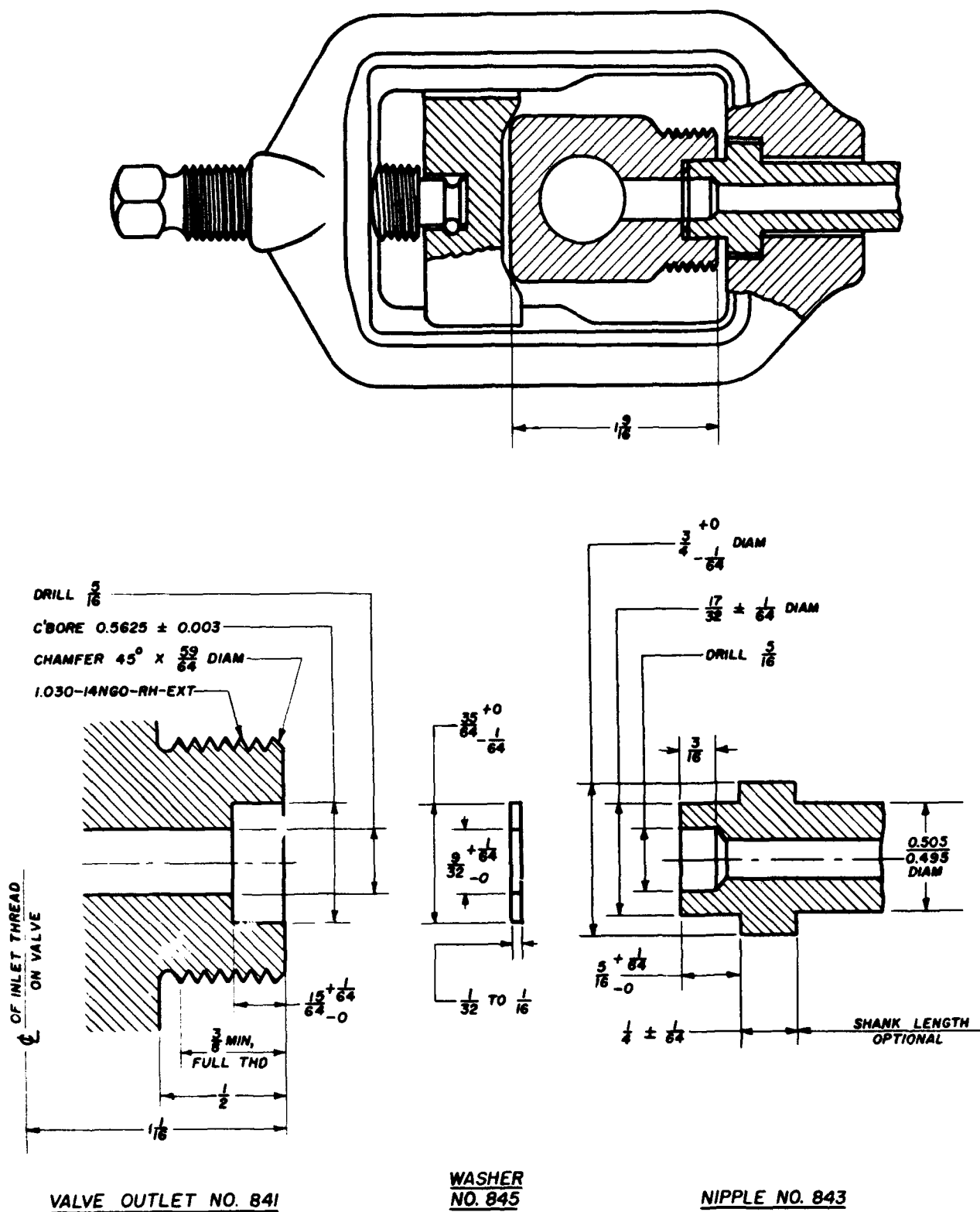
Dimensions in inches unless otherwise specified

FIGURE IX.23.—No. 800 standard valve outlet connection, yoke type, for ammonia, anhydrous.



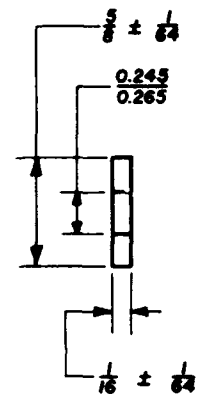
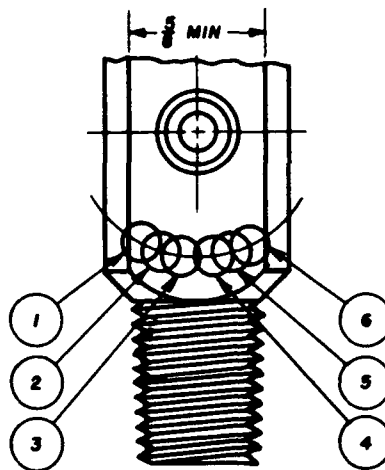
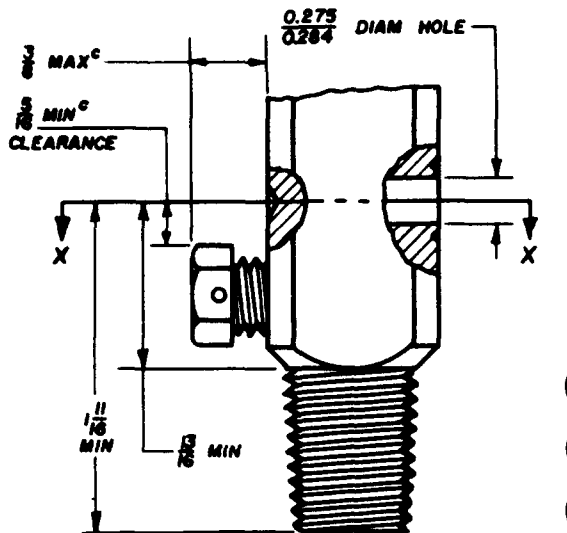
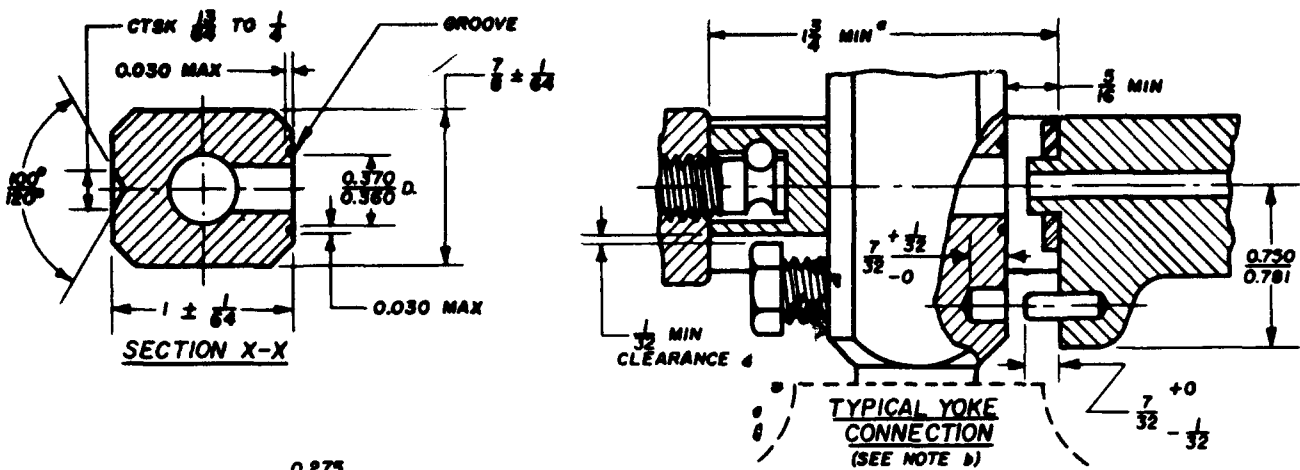
Dimensions in inches unless otherwise specified.

FIGURE IX.24.—No. 820 standard valve outlet connection, yoke type, for chlorine (with washer on outer face).



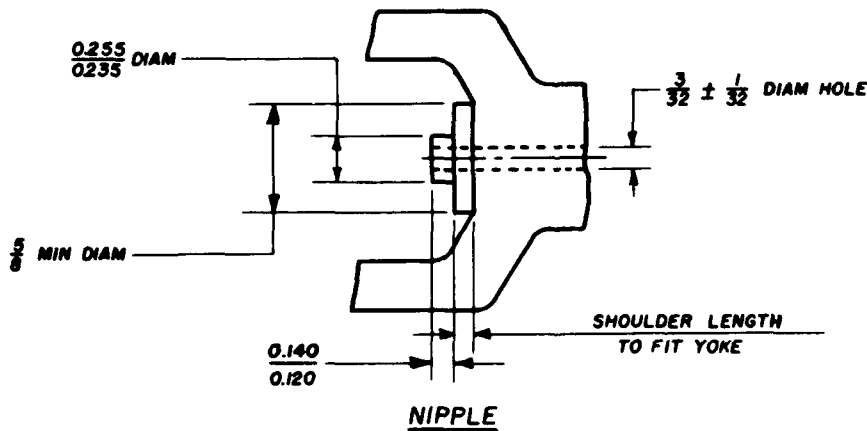
Dimensions in inches unless otherwise specified.

FIGURE IX.25.—No. 840 standard valve outlet connection, yoke type, for chlorine (with washer inside of recess).



**VALVE OUTLET**

**WASHER NO. 875**  
(THIS WASHER ALSO USED  
WITH NO. 880 THROUGH  
NO. 940 VALVE OUTLET  
CONNECTIONS)

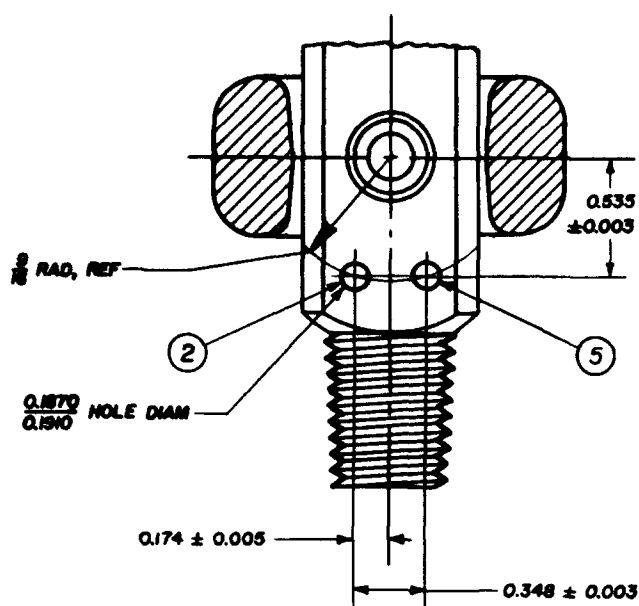


**NIPPLE**

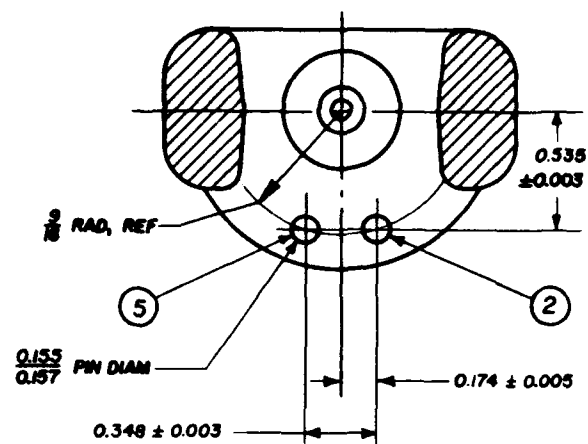
- \* 1 3/4" may be reduced to 1 3/8" if clearance is provided for projecting safety nut.
- <sup>b</sup> Yoke or stabilizer shall be so dimensioned as to limit its rotation on the valve to ±6 degrees.
- <sup>c</sup> Applicable only if projecting type safety is used.

Dimensions in inches unless otherwise specified.

**FIGURE IX.26.—No. 870 through No. 940 valve outlet connections, yoke type, basic dimensions.**



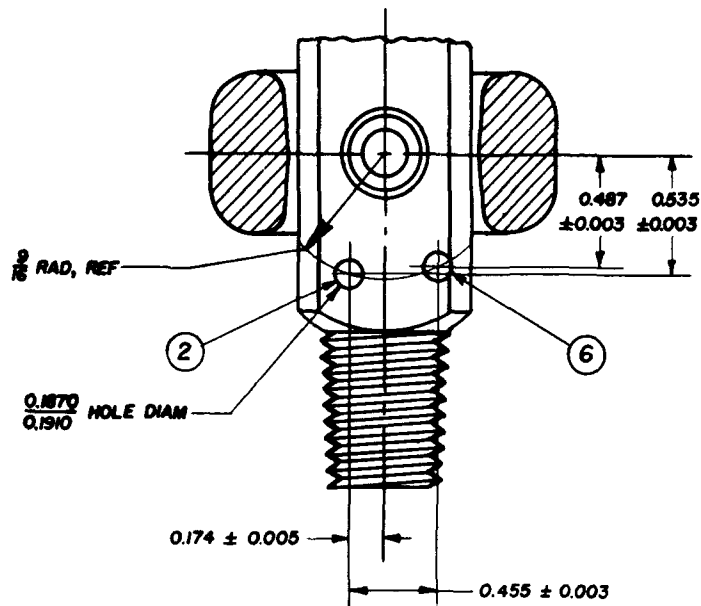
**VALVE OUTLET NO. 871**



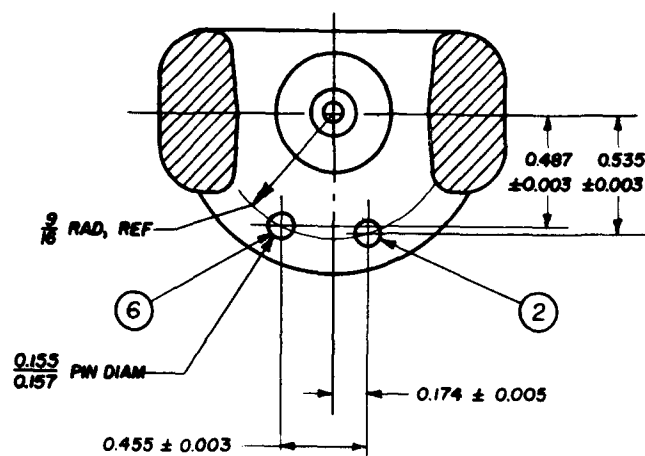
**NIPPLE NO. 873**

For basic dimensions see figure IX.26.  
Dimensions in inches unless otherwise specified.

FIGURE IX.27.—No. 870 standard valve outlet connection, yoke type, for oxygen, medical.



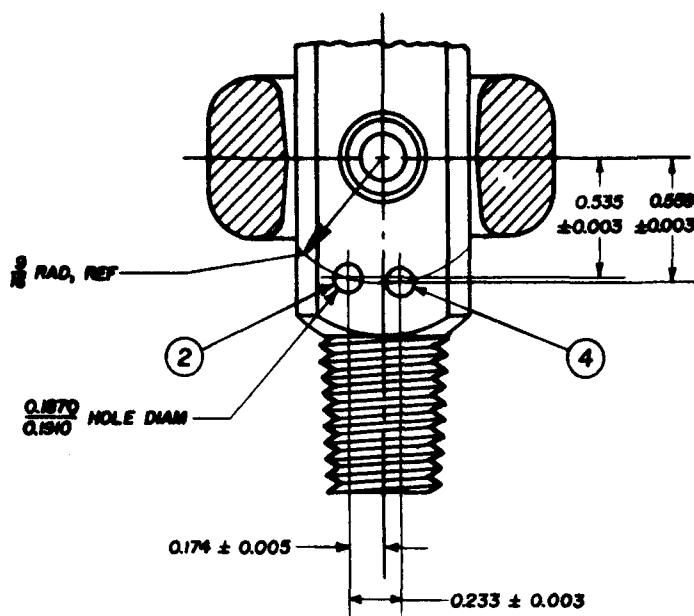
**VALVE OUTLET NO. 881**



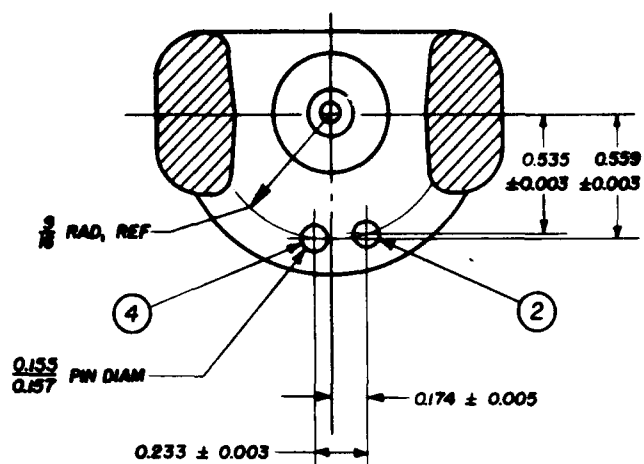
**NIPPLE NO. 883**

For basic dimensions see figure IX.26.  
Dimensions in inches unless otherwise specified.

FIGURE IX.28.—No. 880 standard valve outlet connection, yoke type, for oxygen-carbon dioxide mixture ( $\text{CO}_2$  not over 7 per cent), medical.



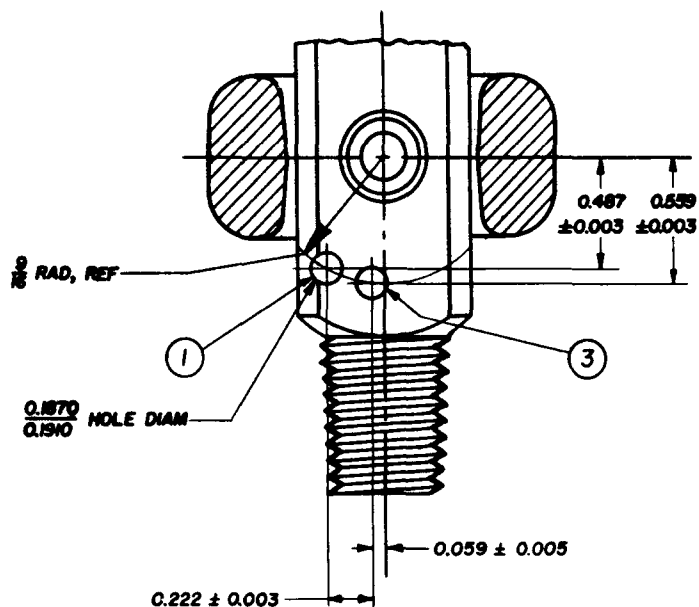
**VALVE OUTLET NO. 891**



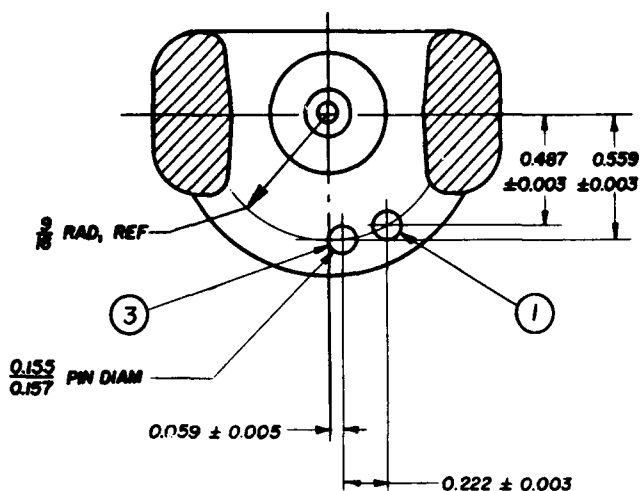
**NIPPLE NO. 893**

For basic dimensions see figure IX.26.  
Dimensions in inches unless otherwise specified.

FIGURE IX.29.—No. 890 standard valve outlet connection, yoke type, for oxygen-helium mixtures (helium not over 80 per cent), medical.



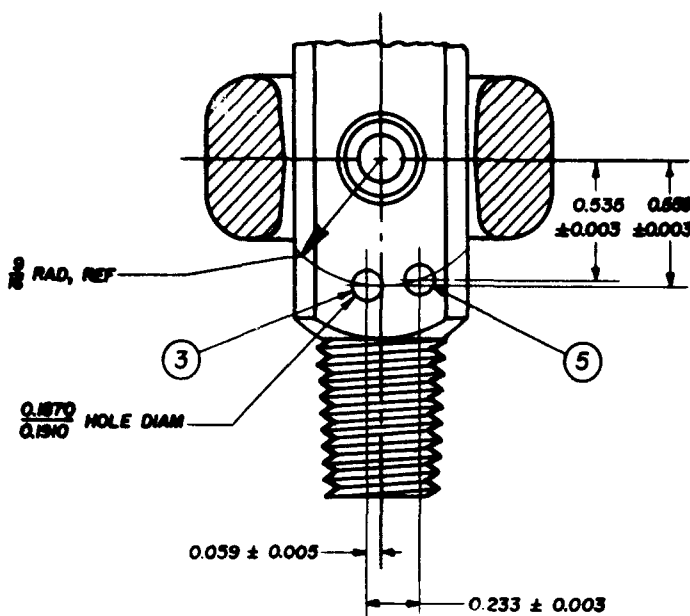
**VALVE OUTLET NO. 901**



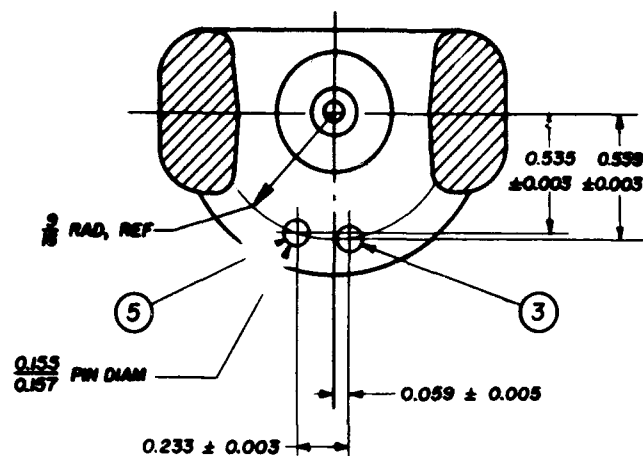
**NIPPLE NO. 903**

For basic dimensions see figure IX.26.  
Dimensions in inches unless otherwise specified.

FIGURE IX.30.—No. 900 standard valve outlet connection, yoke type, for ethylene, medical.



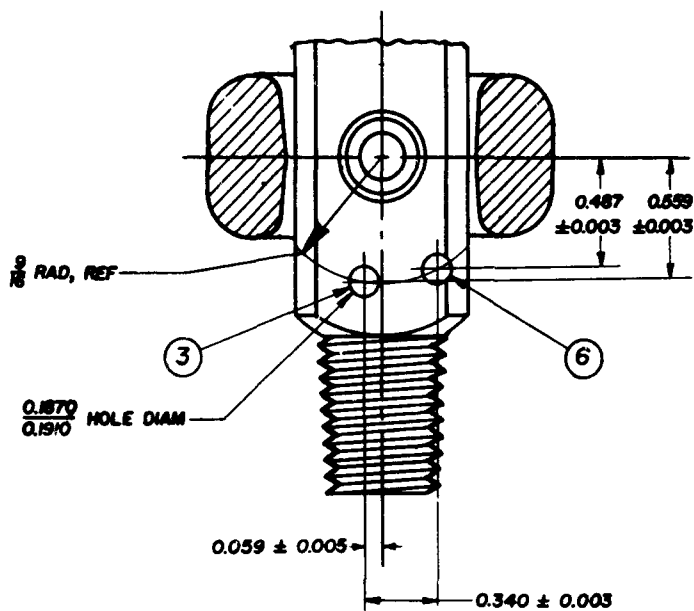
**VALVE OUTLET NO. 911**



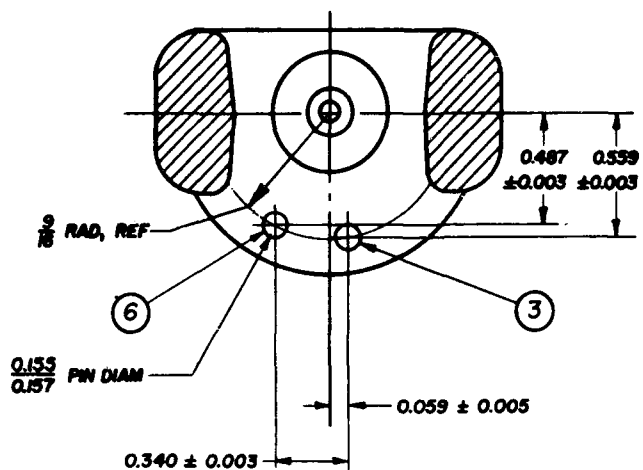
**NIPPLE NO. 913**

For basic dimensions see figure IX.26.  
Dimensions in inches unless otherwise specified.

FIGURE IX.31.—No. 910 standard valve outlet connection, yoke type, for nitrous oxide, medical.



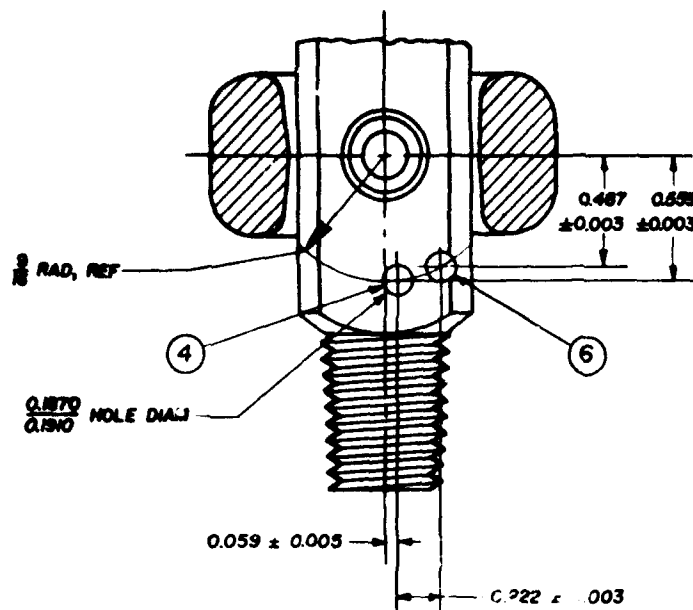
**VALVE OUTLET NO. 921**



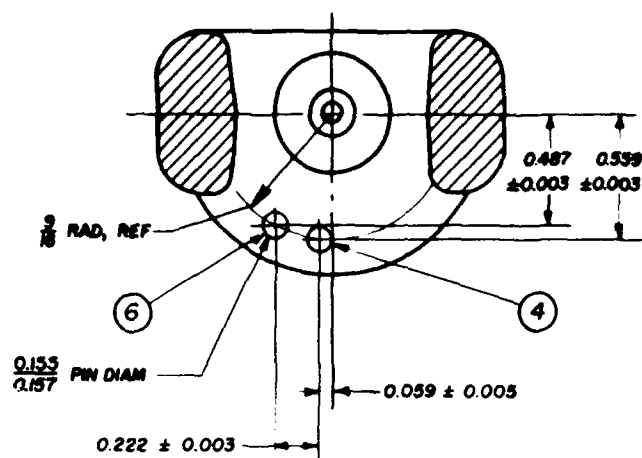
**NIPPLE NO. 923**

For basic dimensions see figure IX.26.  
Dimensions in inches unless otherwise specified.

FIGURE IX.32.—No. 920 standard valve outlet connection, yoke type, for cyclopropane, medical.



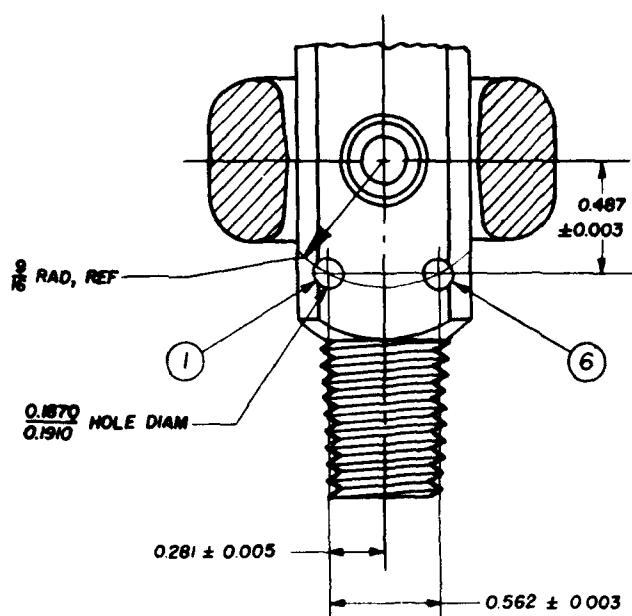
**VALVE OUTLET NO. 931**



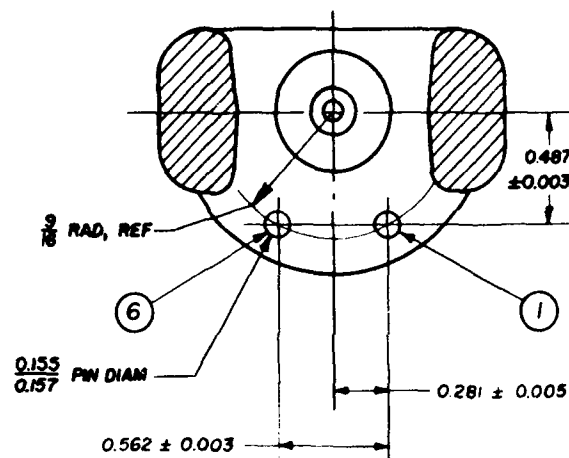
**NIPPLE NO. 933**

For basic dimensions see figure IX.26.  
Dimensions in inches unless otherwise specified.

FIGURE IX.33.—No. 930 standard valve outlet connection, yoke type, for helium, medical; and helium-oxygen mixture ( $O_2$  less than 20 percent), medical.



**VALVE OUTLET NO. 941**



**NIPPLE NO. 943**

For basic dimensions see figure IX.26.  
Dimensions in inches unless otherwise specified.

FIGURE IX.34.—No. 940 standard valve outlet connection, yoke type, for carbon dioxide, medical; and carbon dioxide-oxygen mixture ( $CO_2$  over 7 percent), medical.

TABLE IX.4.—Limits of size of U.S. compressed gas cylinder valve outlet threads, NGO

| Thread designation  | External thread |        |                |        |                | Internal thread |        |                |        |                |
|---------------------|-----------------|--------|----------------|--------|----------------|-----------------|--------|----------------|--------|----------------|
|                     | Major diameter  |        | Pitch diameter |        | Minor diameter | Minor diameter  |        | Pitch diameter |        | Major diameter |
|                     | Max             | Min    | Max            | Min    | Max            | Min             | Max    | Min            | Max    | Min            |
| 1                   | 2               | 3      | 4              | 5      | 6              | 7               | 8      | 9              | 10     | 11             |
|                     | in.             | in.    | in.            | in.    | in.            | in.             | in.    | in.            | in.    | in.            |
| 373-24NGO-RH-EXT.   | 0.3730          | 0.3680 | 0.3459         | 0.3435 | 0.3219         | 0.3299          | 0.3344 | 0.3479         | 0.3503 | 0.3750         |
| 375-24NGO-RH-INT.   |                 |        |                |        |                |                 |        |                |        |                |
| 625-20NGO-RH-EXT.   | .6250           | .6200  | .5925          | .5895  | .5637          | .5739           | .5793  | .5955          | .5985  | .6280          |
| 628-20NGO-RH-INT.   |                 |        |                |        |                |                 |        |                |        |                |
| 745-14NGO-RH-EXT.   | .7450           | .7400  | .6986          | .6950  | .6574          |                 |        |                |        |                |
| 750-14NGO-RH-INT.   |                 |        |                |        |                | .6727           | .6804  | .7036          | .7072  | .7500          |
| 825-14NGO-RH-EXT.   | .8250           | .8200  | .7786          | .7750  | .7374          |                 |        |                |        |                |
| 830-14NGO-RH-INT.   |                 |        |                |        |                | .7527           | .7604  | .7836          | .7872  | .8300          |
| 880-14NGO-LH-EXT.   | .8800           | .8750  | .8336          | .8300  | .7924          |                 |        |                |        |                |
| 885-14NGO-LH-INT.   |                 |        |                |        |                | .8077           | .8154  | .8386          | .8422  | .8850          |
| 895-18NGO-RH-EXT.   | .8950           | .8900  | .8589          | .8553  | .8268          | .8389           | .8449  | .8629          | .8665  | .8900          |
| 899-18NGO-RH-INT.   |                 |        |                |        |                |                 |        |                |        |                |
| 903-14NGO-RH-EXT.   | .9030           | .8980  | .8566          | .8530  | .8154          | .8307           | .8384  | .8616          | .8652  | .9080          |
| 906-14NGO-RH-INT.   |                 |        |                |        |                |                 |        |                |        |                |
| 960-14NGO-RH-EXT.   | .9600           | .9550  | .9136          | .9100  | .8724          |                 |        |                |        |                |
| 965-14NGO-RH-INT.   |                 |        |                |        |                | .8877           | .8954  | .9186          | .9222  | .9650          |
| 1.030-14NGO-RH-EXT. | 1.0300          | 1.0250 | .9836          | .9796  | .9424          |                 |        |                |        |                |
| 1.035-14NGO-RH-INT. |                 |        |                |        |                | .9577           | .9654  | .9886          | .9926  | 1.0350         |

TABLE IX.5.—Limits of size, National Gas Taper, Special Gas Taper threads; NGT, NGT(Cl), SGT

| Thread designation <sup>a</sup> | Hand-tight engagement, $T_1$ | External              |                       |                             |                       |               |                                   |                                    | Internal               |                               |                            |                   |                       |                       |                                  |
|---------------------------------|------------------------------|-----------------------|-----------------------|-----------------------------|-----------------------|---------------|-----------------------------------|------------------------------------|------------------------|-------------------------------|----------------------------|-------------------|-----------------------|-----------------------|----------------------------------|
|                                 |                              | Small end             |                       |                             | Full threads          |               | Large end                         |                                    | Neck radius, min., $G$ | Pitch diameter at face, $E_1$ | C/sink 90° x max. diameter | Full threads      |                       |                       |                                  |
|                                 |                              | Major diameter, $D_0$ | Pitch diameter, $E_0$ | Chamfer 45° x min. diameter | Pitch diameter, $E_1$ | Length, $L_1$ | Major diameter, approx., $D_{10}$ | Over-all length, approx., $L_{10}$ |                        |                               |                            | Bore, max., $K_1$ | Pitch diameter, $E_1$ | Length, $(L_1 + L_2)$ | Length of full root, min., $L_2$ |
| 1                               | 2                            | 3                     | 4                     | 5                           | 6                     | 7             | 8                                 | 9                                  | 10                     | 11                            | 12                         | 13                | 14                    | 15                    | 16                               |
|                                 | in.                          | in.                   | in.                   | in.                         | in.                   | in.           | in.                               | in.                                | in.                    | in.                           | in.                        | in.               | in.                   | in.                   | in.                              |
| 1/8-27NGT                       | 0.1800                       | 0.3931                | 0.3635                | 2 3/64                      | 0.3886                | 0.4022        | 0.4204                            | 3 1/8                              | 9/32                   | 0.3748                        | 1 3/64                     | 0.3269            | 0.3586                | 0.2911                | 0.3652                           |
| 1/4-18NGT                       | .2000                        | .5318                 | .4774                 | 27/64                       | .5107                 | .5333         | .5530                             | 5/8                                | 3/8                    | .4899                         | 9/16                       | .4225             | .4670                 | .3667                 | .4778                            |
| 3/8-18NGT                       | .2400                        | .6564                 | .6120                 | 9/16                        | .6479                 | .6733         | .6915                             | 1 1/16                             | 7/16                   | .6270                         | 1 1/16                     | .5572             | .6016                 | .4067                 | .5178                            |
| 1/2-14NGT                       | .3200                        | .8156                 | .7584                 | 1 1/16                      | .8052                 | .7486         | .8625                             | 3/4                                | 9/16                   | .7784                         | 7/8                        | .6879             | .7450                 | .5343                 | .6771                            |
| 3/4-14NGT                       | .3390                        | 1.0248                | .9677                 | 29/32                       | 1.0157                | .7676         | 1.0795                            | 7/8                                | 1 1/8                  | .9889                         | 1 1/8                      | .8972             | .9543                 | .5533                 | .6961                            |
| 3/4-14NGT(Cl)-1                 | .3390                        | 1.0248                | .9677                 | 29/32                       | 1.0268                | .9461         | 1.0951                            | 1 1/8                              | 1 1/8                  | .9889                         | 1 1/8                      | .8972             | .9543                 | .5533                 | .9461                            |
| 3/4-14NGT(Cl)-2                 | .3390                        | 1.0427                | .9856                 | 59/64                       | 1.0447                | .9461         | 1.1130                            | 1 1/8                              | (*)                    | (*)                           | (*)                        | (*)               | (*)                   | (*)                   | (*)                              |
| 3/4-14NGT(Cl)-3                 | .3390                        | 1.0628                | 1.0057                | 1 1/16                      | 1.0648                | .9461         | 1.1331                            | 1 1/8                              | (*)                    | (*)                           | (*)                        | (*)               | (*)                   | (*)                   | (*)                              |
| 3/4-14NGT(Cl)-4                 | .3390                        | 1.0873                | 1.0302                | 31/32                       | 1.0893                | .9461         | 1.1576                            | 1 1/8                              | (*)                    | (*)                           | (*)                        | (*)               | (*)                   | (*)                   | (*)                              |
| 3/4-14SGT                       | .4008                        | 1.047                 | 0.9852                | 59/64                       | 1.0731                | .7030         | 1.1564                            | 7/8                                | 1 1/8                  | 1.0353                        | 1 7/8                      | .8556             | .9474                 | .5714                 | .7030                            |
| 1-11 1/2NGT                     | .4000                        | 1.2832                | 1.2136                | 1 1/8                       | 1.2712                | .9217         | 1.3457                            | 1                                  | 1 3/16                 | 1.2386                        | 1 1/8                      | 1.1278            | 1.1973                | .6609                 | .8348                            |
| 1 1/4-11 1/2NGT                 | .4200                        | 1.6267                | 1.5571                | 1 1/2                       | 1.6160                | .9417         | 1.6931                            | 1 1/8                              | 1                      | 1.5834                        | 1 3/4                      | 1.4713            | 1.5408                | .6809                 | .8548                            |
| 1 1/2-11 1/2NGT                 | .4200                        | 1.8657                | 1.7961                | 1 1/2                       | 1.8550                | .9417         | 1.9360                            | 1 1/8                              | 1 1/2                  | 1.8223                        | 1 3/2                      | 1.7102            | 1.7798                | .6809                 | .8548                            |

All dimensions are basic. See figure IX.35 for relationship of dimensions.

<sup>a</sup> For uses other than chlorine, oversize threads for revalving are generally specified at 4 or 7 turns oversize. For chlorine, the 3/4-14NGT(Cl)-1 size is standard; the -2 is 4 turns oversize; the -3 is 8 1/2 turns oversize; and the -4 is 14 turns oversize.

<sup>b</sup> The 3/4-14SGT (Special Gas Taper) thread is a standard having a taper of 3/8 (= 1 1/2 inches per foot on diameter) with a 60° thread normal to the axis and 0.0618 inch deep. For this thread col. 13, 14 and 15 are based on gages 0.7030 inch long. Cylinders are held to final inspection limits from basic to 1 1/2 turns small, and valves to plus or minus 1 turn.

<sup>c</sup> The basic condition of fit is that the external thread with a pitch diameter of  $E_0$  at the end (reference plane for gaging external thread) shall enter by hand engagement to a distance  $L_1$  into the internal thread with a pitch diameter of  $E_1$  at the opening (reference plane for gaging internal thread).

<sup>d</sup> External threads shall be threaded the approximate length  $L_{10}$  but gaged up to  $L_2$ . Dimension  $L_2$  is equal to  $L_1$  plus six (6) threads for all NGT threads and  $L_1$  plus eight and a half (8 1/2) threads for the NGT(Cl) threads. Dimension  $E_0$  is measured at distance  $L_2$  from  $E_0$ , and dimension  $D_{10}$  is measured at distance  $L_{10}$  from  $E_0$ . These longer external threads are desirable if further tightening should be necessary. To facilitate gaging, provision should be made to allow the  $L_2$  ring gage to advance a distance of two full threads beyond the  $L_2$  length (one turn for allowable variation in pitch diameter and one turn for allowable variation in taper).

<sup>e</sup> Full internal threads at the crests and roots shall extend throughout lengths  $L_1 + L_2$  ( $L_2 = 3$  threads). This dimension determines the minimum metal on the inside of the neck to produce maximum bore  $K_1$ . Any metal below  $L_2$  shall have tapered threads with full roots to a minimum length  $L_2$  ( $L_1 + 5$  threads for all NGT threads and  $L_1 + 8 1/2$  threads for the NGT(Cl) threads).

### 3. INLET CONNECTIONS

The threads on the inlet, neck, or valve to cylinder connection are right hand of the following types:

(a) National gas taper threads, NGT or NGT (Cl) for chlorine.

(b) Special gas taper threads, SGT.

(c) National gas straight threads, NGS.

1. NGT, NGT(Cl), AND SGT THREADS.—The NGT and NGT(Cl) threads are based on the American Standard for taper pipe threads but are longer to provide fresh threads if further tightening is necessary. Manufacturing tolerances for the taper of these threads are as follows:

The taper on the pitch elements of *external* threads is  $\frac{1}{16}$  on diameter, ( $=\frac{3}{4}$  in./ft.) with a minus tolerance of one turn but with no plus tolerance in gaging.

The taper on the pitch elements of *internal* threads is  $\frac{1}{16}$  on diameter, with a plus tolerance of one turn but with no minus tolerance in gaging.

The limits on crest and root truncation are the same as for the American National taper pipe threads as shown in table VII.1, p. 4.

The SGT threads are similar to the NGT threads except that the taper is  $\frac{1}{8}$  ( $=1\frac{1}{2}$  in./ft.) on diameter instead of  $\frac{1}{16}$ .

(a). *Limits of size for the NGT, NGT(Cl), and SGT threads.*—Limits of size for these threads are given in table IX.5. (See footnote b of that table.) Figure IX.35 indicates the relationship of these dimensions.

(b). *Gaging of the NGT, NGT(Cl), and SGT threads.*—Special gages are required for the gaging of these threads because of their length and the rigid requirements for sealing the compressed gas against leakage. The working or inspection gages described in this section are called *ramp gages*. Ramp gages are similar to conventional taper pipe thread gages but provide more positive control of the thread elements; however, other gages acceptable to the procuring agency may be used.

1. *Pitch diameter of external thread*—To check the pitch diameter of the external thread, the threaded ring gages shown on figure IX.36 are used. The  $L_1$  ring gage is known as a *primary* gage since the reading taken on the ramp will be needed for use when additional gaging is done.

The  $L_8$  ring is screwed onto the valve, flat face first. The  $L_1$  ring is then screwed onto the valve. Both rings should be engaged to about the same tightness. For the thread to be acceptable, the rim of the  $L_8$  ring should not project above the  $L_1$  ring or below the bottom of the gaging notch on the  $L_1$  ring.

The numbers on the ramp ring indicate the quarters of a turn the thread varies from basic. While the  $L_1$  and  $L_8$  rings are screwed onto the valve, the plunger should be pushed down against the end of the valve. The reading on the ramp should then be taken. The reading will be the number within the division where the helical scale

or ramp intersects the edge of the collar on the body.

The threads are to be within one turn in either direction from basic but preferably within  $\frac{1}{2}$  turn from basic. Therefore the product should gage preferably between  $-2$  and  $+2$  on the scale with readings between  $-4$  and  $+4$  being acceptable. This reading will be needed as a reference for gaging the crest and root truncation of the external thread.

2. *Crest truncation of external thread.*—To check the crest truncation of the external thread, the gage shown in figure IX.37 is used. The gage should be placed over the threads lightly and rocked in different directions to detect out-of-roundness or off-taper. If the rock is not excessive, the plunger should be pushed down and a reading taken. If the edge of the collar on the body lies within the helical ramp at the same reading as was shown on the ramp of the pitch diameter ring gage (fig. IX.36), the crest truncation of the external thread is acceptable.

3. *Root truncation of external thread.*—To check the root truncation of the external thread, the gage shown in figure IX.38 is used. The gage is screwed delicately onto the valve. After reaching full engagement, the gage is backed off one-half to one full turn, and the degree of looseness is compared with that of generally accepted threads. Slight looseness indicates that the gage and product bear along the length of a full and continuous or cleared thread. Considerable looseness indicates that the gage has seated or stopped on the last incomplete thread.

If the thread appears to be satisfactory after the above preliminary check, the gage is screwed onto the valve fingertight. The plunger is then pushed down and a reading taken. If the edge of the collar on the body lies within the helical ramp at the same reading as was shown on the ramp of the pitch diameter ring gage (fig. IX.36), the root truncation of the external thread is acceptable.

4. *Pitch diameter of internal thread.*—To check the pitch diameter of the internal thread, the threaded plug gage shown on figure IX.39 is used. This gage is known as a *primary* gage since the reading taken on the ramp will be needed for use when additional gaging is done.

Both heads are screwed in simultaneously, with the precaution that the  $L_8$  section advances with some clearance ahead of the  $L_1$  section to prevent locking. Both sections should be screwed in to about the same tightness. For the pitch diameter of the tapped hole to be acceptable, the upper band should not be above or below the edge of the gaging ring.

To measure the effective pitch diameter of the thread at the  $L_1$  length, with the gage screwed into the cylinder, the hexagonal sleeve is pushed down to the face of the cylinder. A reading is then taken on the ramp at the point where it

intersects the edge of the hexagonal sleeve.

The threads are to be within one turn in either direction from basic but preferably within  $\frac{1}{2}$  turn from basic. Therefore the product should gage preferably between  $-2$  and  $+2$  on the scale, with readings between  $-4$  and  $+4$  being acceptable. This reading will be needed as a reference for gaging the crest and root truncation and the maximum bore of the internal thread on the cylinder.

5. *Crest truncation of internal thread.*—To check the crest truncation of the internal thread, the plain plug gage shown in figure IX.40 is used.

The plug is slipped lightly into the hole and rocked in different directions to detect out-of-roundness or off-taper. If either of these conditions appears excessive, the crest should be examined visually for roughness, chips, and variations in truncation.

After this inspection, the plug is seated into the hole and the hexagonal sleeve pushed down to the face of the cylinder. If the upper edge of the hexagonal sleeve lies within the helical ramp at the same reading as was shown on the ramp of the pitch diameter plug gage (fig. IX.39), the crest truncation of the internal thread is acceptable.

6. *Maximum bore of internal thread.*—To check the maximum bore of the internal thread, the gage shown in figure IX.41 is used.

The plug is seated into the hole and the hexagonal sleeve pushed down to the face of the cylinder. If the upper edge of the hexagonal sleeve lies within the helical ramp at the same reading as was shown on the ramp of the pitch diameter plug gage (fig. IX.39), the maximum bore of the internal thread is acceptable.

7. *Root truncation of internal thread.*—To check the root truncation of the internal thread, the threaded plug gage shown on figure IX.42 is used. The gage is screwed delicately into the tapped hole of the cylinder. After reaching full engagement, the gage is backed off one-half to one full turn and the degree of looseness compared with that of generally accepted threads. Slight looseness indicates that the gage and cylinder bear along the length of a full and continuous or cleared thread. Considerable looseness indicates that the plug has seated or stopped on the last incomplete thread.

If the thread appears to be satisfactory after the above preliminary check, the gage is screwed into the cylinder fingertight. The hexagonal sleeve is then pushed down to the face of the

cylinder. If the upper edge of the hexagonal sleeve lies within the helical ramp at the same reading as was shown on the ramp of the pitch diameter plug gage (fig. IX.39), the root truncation of the internal thread is acceptable.

(c) *Checking of the NGT, NGT(Cl), and SGT working or inspection gages with master gages.*—The sketches of the master gages are shown on figures IX.43, IX.44, and IX.45. Gaging information is given in the notes on these figures.

2. NATIONAL GAS STRAIGHT THREADS, NGS.—All straight threads for inlet connections shall be NGS threads. The diameters and the form for both the external and internal threads shall conform to those for NPSM American Standard straight pipe threads for free-fitting mechanical joints (without clearance) (see table VII.6, p. 9). The length of engagement shall be  $(L_1 + L_3)$ . The seal for tightness shall be at or close to the end face of the cylinder whether it incorporates the external or the internal threads.

#### 4. SAFETY DEVICE THREADS

The safety devices on high pressure gas cylinder valves shall be provided with right hand threads of the Unified form, 19 threads per inch. The minimum length of engagement shall be  $\frac{1}{2}$  in. The thread dimensions shall be as follows:

|                     | Boss (external thread) |                       | Cap (internal thread) |                     |
|---------------------|------------------------|-----------------------|-----------------------|---------------------|
|                     | Max                    | Min                   | Min                   | Max                 |
| Major diameter..... | <i>in.</i><br>0.6500   | <i>in.</i><br>*0.6416 | <i>in.</i><br>0.6500  | <i>in.</i><br>..... |
| Pitch diameter..... | .6157                  | *.6124                | .6157                 | *.6200              |
| Minor diameter..... | .5852                  | .....                 | .5929                 | *.6008              |

The safety device threads shall be designated as follows:

- \* Boss (external thread):  
.650-19 UNS-3A  
MAJOR DIA .6500-.6416  
PD .6157-.6124
- \* Cap (internal thread):  
.650-19 UNS-3B  
MINOR DIA .5929-.6008  
PD .6157-.6200

TABLE IX.6.—Dimensions of master setting plug gages; NGT, SGT\* (external threads)

|                                       | $\frac{1}{8}$ -27NGT | $\frac{1}{8}$ -18NGT | $\frac{3}{16}$ -18NGT | $\frac{1}{2}$ -14NGT | $\frac{5}{8}$ -14NGT | $\frac{3}{4}$ -14NGT(CI)-1 | $\frac{3}{4}$ -14NGT(CI)-2 | $\frac{3}{4}$ -14NGT(CI)-3 | $\frac{3}{4}$ -14NGT(CI)-4 | $\frac{3}{4}$ -14SGT | 1-11 $\frac{1}{2}$ NGT | 1 $\frac{1}{2}$ -11 $\frac{1}{2}$ NGT | 1 $\frac{1}{2}$ -11 $\frac{1}{2}$ NGT |
|---------------------------------------|----------------------|----------------------|-----------------------|----------------------|----------------------|----------------------------|----------------------------|----------------------------|----------------------------|----------------------|------------------------|---------------------------------------|---------------------------------------|
| 1                                     | 2                    | 3                    | 4                     | 5                    | 6                    | 7                          | 8                          | 9                          | 10                         | 11                   | 12                     | 13                                    | 14                                    |
| $D_0$ .....                           | in.<br>0.3931        | in.<br>0.5218        | in.<br>0.6564         | in.<br>0.8156        | in.<br>1.0248        | in.<br>1.0248              | in.<br>1.0427              | in.<br>1.0828              | in.<br>1.0873              | in.<br>1.0470        | in.<br>1.2832          | in.<br>1.6267                         | in.<br>1.8657                         |
| $D_1$ .....                           | .4044                | .5343                | .6714                 | .8356                | 1.0460               | 1.0460                     | 1.0639                     | 1.0840                     | 1.1065                     | 1.0971               | 1.3082                 | 1.6530                                | 1.8920                                |
| $D$ (a-p).....                        | .4160                | .5517                | .6888                 | .8579                | 1.0683               | 1.0683                     | 1.0862                     | 1.1063                     | 1.1308                     | *1.1260              | 1.3354                 | 1.6802                                | 1.9192                                |
| $D_{10}$ , approx.....                | .4204                | .5530                | .6915                 | .8626                | 1.0795               | 1.0861                     | 1.1130                     | 1.1331                     | 1.1576                     | 1.1564               | 1.3457                 | 1.6931                                | 1.9360                                |
| $E_0$ .....                           | .3635                | .4774                | .6120                 | .7584                | .9677                | .9677                      | .9856                      | 1.0057                     | 1.0302                     | .9852                | 1.2136                 | 1.5571                                | 1.7961                                |
| $E_1$ — $\frac{1}{2}$ thd height..... | .3475                | .4534                | .5880                 | .7375                | .9368                | .9368                      | .9547                      | .9748                      | .9903                      | .9543                | 1.1760                 | 1.5195                                | 1.7585                                |
| $E_1$ .....                           | .3748                | .4899                | .6270                 | .7784                | .9889                | .9889                      | 1.0068                     | 1.0269                     | 1.0514                     | 1.0353               | 1.2386                 | 1.5834                                | 1.8223                                |
| $E_2$ (a-p).....                      | .3771                | .4934                | .6305                 | .7829                | .9934                | .9934                      | 1.0113                     | 1.0314                     | 1.0559                     | 1.0443               | 1.2440                 | 1.5888                                | 1.8277                                |
| $E_3$ .....                           | .3886                | .5107                | .6479                 | .8052                | 1.0157               | 1.0288                     | 1.0447                     | 1.0648                     | 1.0893                     | 1.0731               | 1.2712                 | 1.6160                                | 1.8550                                |
| $E_4$ — $\frac{1}{2}$ thd height..... | .3726                | .4867                | .6239                 | .7743                | .9848                | .9848                      | 1.0138                     | 1.0339                     | 1.0584                     | 1.0422               | 1.2336                 | 1.5784                                | 1.8174                                |
| $K_0$ .....                           | *.3339               | .4329                | .5676                 | .7013                | .9106                | .9106                      | .9285                      | .9486                      | .9731                      | *.9234               | 1.1441                 | 1.4876                                | 1.7265                                |
| $K_1$ (a-p).....                      | *.3567               | .4628                | .6000                 | .7436                | .9541                | .9541                      | .9720                      | .9921                      | 1.0166                     | *1.0024              | 1.1963                 | 1.5411                                | 1.7800                                |
| $L_1$ .....                           | .1800                | .2000                | .2400                 | .3200                | .3390                | .3390                      | .3390                      | .3390                      | .4008                      | .4008                | .4200                  | .4200                                 | .4200                                 |
| $L_2$ .....                           | .4022                | .5333                | .6733                 | .7486                | .7676                | .9461                      | .9461                      | .9461                      | .9461                      | .7030                | .9217                  | .9417                                 | .9417                                 |
| $L_3$ (a-p).....                      | .3652                | .4777                | .6177                 | .7672                | .9662                | .8747                      | .8747                      | .8747                      | .8747                      | .6316                | .8347                  | .8547                                 | .8547                                 |
| $L_4$ , approx.....                   | $\frac{1}{16}$       | $\frac{3}{16}$       | $\frac{1}{4}$         | $\frac{1}{2}$        | $\frac{3}{4}$        | $1\frac{1}{8}$             | $1\frac{1}{8}$             | $1\frac{1}{8}$             | $1\frac{1}{8}$             | $\frac{1}{2}$        | 1                      | $1\frac{1}{2}$                        | $1\frac{1}{2}$                        |
| $p$ , pitch*.....                     | *.03704              | *.05556              | *.05556               | *.07143              | *.07143              | *.07143                    | *.07143                    | *.07143                    | *.07143                    | *.07143              | *.08696                | *.08696                               | *.08696                               |
| Chamfer 45° x min. dia.....           | $\frac{3}{16}$       | $\frac{7}{16}$       | $\frac{1}{2}$         | $\frac{1}{2}$        | $\frac{3}{4}$        | $\frac{3}{4}$              | $\frac{3}{4}$              | $\frac{3}{4}$              | $\frac{3}{4}$              | $\frac{3}{4}$        | $1\frac{1}{8}$         | $1\frac{1}{8}$                        | $1\frac{1}{8}$                        |
| $H$ , ref*.....                       | *.2644               | .3824                | .3824                 | .4912                | .4912                | .6688                      | .6688                      | .6688                      | .6688                      | *.3184               | .5968                  | .5968                                 | .5968                                 |
| $M$ , ref*.....                       | *.6196               | .8001                | .9001                 | 1.1684               | 1.1874               | 1.5435                     | 1.5435                     | 1.5435                     | 1.5435                     | *.9500               | 1.4315                 | 1.4515                                | 1.4531                                |

See figure IX.35, p. 81, for the explanation of all letter symbols except H and M, which are identified on figure IX.45, p. 90.

TABLE IX.7.—Dimensions of master setting ring gages; NGT, SGT\* (internal threads)

|                                       | $\frac{1}{8}$ -27NGT | $\frac{1}{8}$ -18NGT | $\frac{3}{16}$ -18NGT | $\frac{1}{2}$ -14NGT | $\frac{5}{8}$ -14NGT | $\frac{3}{4}$ -14NGT(CI)-1 | $\frac{3}{4}$ -14NGT(CI)-2 | $\frac{3}{4}$ -14NGT(CI)-3 | $\frac{3}{4}$ -14NGT(CI)-4 | $\frac{3}{4}$ -14SGT | 1-11 $\frac{1}{2}$ NGT | 1 $\frac{1}{2}$ -11 $\frac{1}{2}$ NGT | 1 $\frac{1}{2}$ -11 $\frac{1}{2}$ NGT |
|---------------------------------------|----------------------|----------------------|-----------------------|----------------------|----------------------|----------------------------|----------------------------|----------------------------|----------------------------|----------------------|------------------------|---------------------------------------|---------------------------------------|
| 1                                     | 2                    | 3                    | 4                     | 5                    | 6                    | 7                          | 8                          | 9                          | 10                         | 11                   | 12                     | 13                                    | 14                                    |
| $D_0$ .....                           | in.<br>0.3931        | in.<br>0.5218        | in.<br>0.6564         | in.<br>0.8156        | in.<br>1.0248        | in.<br>1.0248              | in.<br>(*)                 | in.<br>(*)                 | in.<br>(*)                 | in.<br>1.0470        | in.<br>1.2832          | in.<br>1.6267                         | in.<br>1.8657                         |
| $D_1$ .....                           | .4044                | .5343                | .6714                 | .8356                | 1.0460               | 1.0460                     | (*)                        | (*)                        | (*)                        | 1.0971               | 1.3082                 | 1.6530                                | 1.8920                                |
| $D$ (a-p).....                        | .4160                | .5517                | .6888                 | .8579                | 1.0683               | 1.0683                     | (*)                        | (*)                        | (*)                        | *1.1260              | 1.3354                 | 1.6802                                | 1.9192                                |
| $D_0$ .....                           | .3815                | .5044                | .6390                 | .7933                | 1.0025               | 1.0025                     | (*)                        | (*)                        | (*)                        | *1.0024              | 1.2580                 | 1.5995                                | 1.8385                                |
| $E_0$ .....                           | .3635                | .4774                | .6120                 | .7584                | .9677                | .9677                      | (*)                        | (*)                        | (*)                        | .9852                | 1.2136                 | 1.5571                                | 1.7961                                |
| $E_1$ .....                           | .3748                | .4899                | .6270                 | .7784                | .9889                | .9889                      | (*)                        | (*)                        | (*)                        | 1.0353               | 1.2386                 | 1.5834                                | 1.8223                                |
| $E_2$ .....                           | .3566                | .4670                | .6016                 | .7450                | .9543                | .9543                      | (*)                        | (*)                        | (*)                        | .9474                | 1.1973                 | 1.5408                                | 1.7798                                |
| $E_3$ .....                           | .3520                | .4601                | .5947                 | .7361                | .9454                | .9454                      | (*)                        | (*)                        | (*)                        | .9295                | 1.1864                 | 1.5299                                | 1.7689                                |
| $E_4$ — $\frac{1}{2}$ thd height..... | .3680                | .4841                | .6187                 | .7670                | .9763                | .9763                      | (*)                        | (*)                        | (*)                        | .9604                | 1.2240                 | 1.5675                                | 1.8065                                |
| $E$ (a- $\frac{1}{2}$ p).....         | .3601                | .4723                | .6069                 | .7517                | .9610                | .9610                      | (*)                        | (*)                        | (*)                        | .9607                | 1.2054                 | 1.5489                                | 1.7879                                |
| $K_1$ .....                           | .3451                | .4454                | .5826                 | .7213                | .9318                | .9318                      | (*)                        | (*)                        | (*)                        | .9325                | 1.1691                 | 1.5139                                | 1.7528                                |
| $K_2$ .....                           | .3269                | .4225                | .5572                 | .6879                | .8972                | .8972                      | (*)                        | (*)                        | (*)                        | *.8856               | 1.1278                 | 1.4713                                | 1.7102                                |
| $K_3$ .....                           | .3223                | .4156                | .5503                 | .6790                | .8883                | .8883                      | (*)                        | (*)                        | (*)                        | .8377                | 1.1169                 | 1.4604                                | 1.6993                                |
| $L_1$ .....                           | .1800                | .2000                | .2400                 | .3200                | .3390                | .3390                      | (*)                        | (*)                        | (*)                        | .4008                | .4000                  | .4200                                 | .4200                                 |
| $L_1+L_2$ .....                       | .2911                | .3667                | .4067                 | .5343                | .5533                | .5533                      | (*)                        | (*)                        | (*)                        | *.7030               | .6609                  | .6809                                 | .6809                                 |
| $L_2$ .....                           | .4022                | .5333                | .6733                 | .7486                | .7676                | .9461                      | (*)                        | (*)                        | (*)                        | .7030                | .9217                  | .9417                                 | .9417                                 |
| $L_3$ (a-p).....                      | .3652                | .4777                | .6177                 | .7672                | .9662                | .8747                      | (*)                        | (*)                        | (*)                        | .6316                | .8347                  | .8547                                 | .8547                                 |
| $L_4$ .....                           | .3652                | .4778                | .6178                 | .7671                | .9661                | .9461                      | (*)                        | (*)                        | (*)                        | .7030                | .8348                  | .8548                                 | .8548                                 |
| $3\frac{1}{2}$ p.....                 | .1296                | .1944                | .1944                 | .2500                | .2500                | .2500                      | (*)                        | (*)                        | (*)                        | .2500                | .3043                  | .3043                                 | .3043                                 |
| $1\frac{1}{2}$ p.....                 | .0556                | .0833                | .0833                 | .1071                | .1071                | .1071                      | (*)                        | (*)                        | (*)                        | .1071                | .1304                  | .1304                                 | .1304                                 |
| $p$ , pitch*.....                     | *.03704              | *.05556              | *.05556               | *.07143              | *.07143              | *.07143                    | (*)                        | (*)                        | (*)                        | *.07143              | *.08696                | *.08696                               | *.08696                               |
| $G$ , sink 90° x max. dia.....        | $\frac{1}{16}$       | $\frac{1}{8}$        | $\frac{1}{4}$         | $\frac{1}{2}$        | $1\frac{1}{8}$       | $1\frac{1}{8}$             | (*)                        | (*)                        | (*)                        | $1\frac{1}{8}$       | $1\frac{1}{8}$         | $1\frac{1}{8}$                        | $1\frac{1}{8}$                        |
| $A$ , ref*.....                       | .5812                | .8026                | .8426                 | 1.0979               | 1.1153               | 1.3653                     | (*)                        | (*)                        | (*)                        | 1.0390               | 1.3468                 | 1.3668                                | 1.3668                                |
| $B$ , ref*.....                       | .2160                | .3248                | .3248                 | .4208                | .4192                | .4192                      | (*)                        | (*)                        | (*)                        | .3360                | .5120                  | .5120                                 | .5120                                 |

See figure IX.35, p. 81, for the explanation of all letter symbols except A and B, which are identified on figure IX.44, p. 89.

TABLE IX.8.—Master setting gage tolerances; NGT, SGT

| Thread designation    | Tolerance on pitch diameter at gaging notch of plug gage | Tolerance <sup>a</sup> on lead in $L_1$ length of gage |                 | Tolerance <sup>b</sup> on half angle |                 | Tolerance <sup>a</sup> on taper in $L_1$ length of gage |                 | Tolerance on major diameter of plug gage at gaging notch | Tolerance on minor diameter of ring gage at large end |
|-----------------------|----------------------------------------------------------|--------------------------------------------------------|-----------------|--------------------------------------|-----------------|---------------------------------------------------------|-----------------|----------------------------------------------------------|-------------------------------------------------------|
|                       |                                                          | Plugs                                                  | Rings           | Plugs                                | Rings           | Plugs                                                   | Rings           |                                                          |                                                       |
| 1                     | 2                                                        | 3                                                      | 4               | 5                                    | 6               | 7                                                       | 8               | 9                                                        | 10                                                    |
|                       | <i>in.</i><br>±                                          | <i>in.</i><br>±                                        | <i>in.</i><br>± | <i>min</i><br>±                      | <i>min</i><br>± | <i>in.</i><br>+                                         | <i>in.</i><br>- | <i>in.</i><br>-                                          | <i>in.</i><br>+                                       |
| 1/4-27NGT.....        | 0.0002                                                   | 0.0002                                                 | 0.0003          | 15                                   | 20              | 0.0003                                                  | 0.0006          | 0.0004                                                   | 0.0004                                                |
| 1/4-18NGT.....        | .0002                                                    | .0002                                                  | .0003           | 15                                   | 20              | .0004                                                   | .0007           | .0006                                                    | .0006                                                 |
| 3/4-18NGT.....        | .0002                                                    | .0002                                                  | .0003           | 15                                   | 20              | .0004                                                   | .0007           | .0006                                                    | .0006                                                 |
| 1/4-14NGT.....        | .0003                                                    | .0002                                                  | .0003           | 10                                   | 15              | .0006                                                   | .0009           | .0010                                                    | .0010                                                 |
| 3/4-14NGT.....        | .0003                                                    | .0002                                                  | .0003           | 10                                   | 15              | .0006                                                   | .0009           | .0010                                                    | .0010                                                 |
| 3/4-14NGT(CI).....    | .0003                                                    | .0002                                                  | .0003           | 10                                   | 15              | .0006                                                   | .0009           | .0010                                                    | .0010                                                 |
| 3/4-14SGT.....        | .0003                                                    | .0002                                                  | .0003           | 10                                   | 15              | .0006                                                   | .0009           | .0010                                                    | .0010                                                 |
| 1-11 1/2 NGT.....     | .0003                                                    | .0003                                                  | .0004           | 10                                   | 15              | .0008                                                   | .0012           | .0010                                                    | .0010                                                 |
| 1 1/4-11 1/2 NGT..... | .0003                                                    | .0003                                                  | .0004           | 10                                   | 15              | .0008                                                   | .0012           | .0010                                                    | .0010                                                 |
| 1 3/4-11 1/2 NGT..... | .0003                                                    | .0003                                                  | .0004           | 10                                   | 15              | .0008                                                   | .0012           | .0010                                                    | .0010                                                 |

<sup>a</sup> The lead and taper on plug and ring gages shall be measured along the pitch line, omitting the imperfect threads at each end.

NOTES.—Maximum possible interchange standoff, any ring against any plug other than its master plug, may occur when taper deviations are zero and all other dimensions are at opposite extreme tolerance limits.

Interchange standoff, any ring against any plug other than its master plug, may occur when all dimensions including taper are midway between opposite tolerance limits.

<sup>b</sup> In solving for the correction in diameter for angle deviations, the average deviation in half angle for the two sides of thread regardless of their signs should be taken.

The large end of the ring gage shall be flush with the gaging notch of its master plug gage within  $\pm 0.002$  in. when assembled handtight.

The tolerance for the length  $L_1$  from small end to gaging notch of the plug gage shall be  $+0.000$ ,  $-0.001$  in.

The tolerance for the overall thread length  $L_2$  of the plug gage shall be  $+0.005$ ,  $-0.000$  in.

The tolerance for the thickness  $L_1$  of the ring gage shall be  $+0.001$ ,  $-0.000$  in.

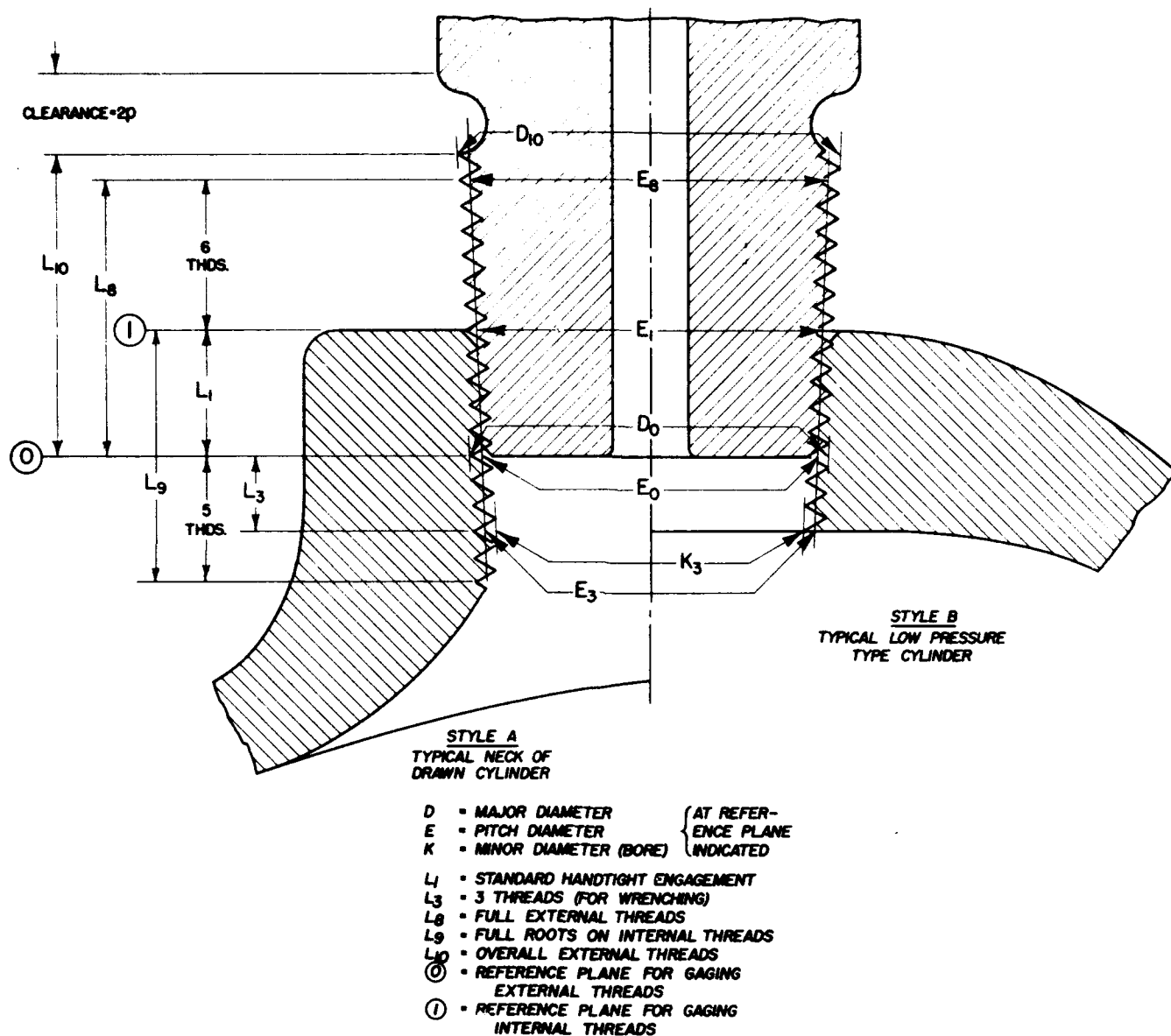


FIGURE IX.35.—Relationship between internal and external thread dimensions of NGT, NGT(Cl), and SGT threads.

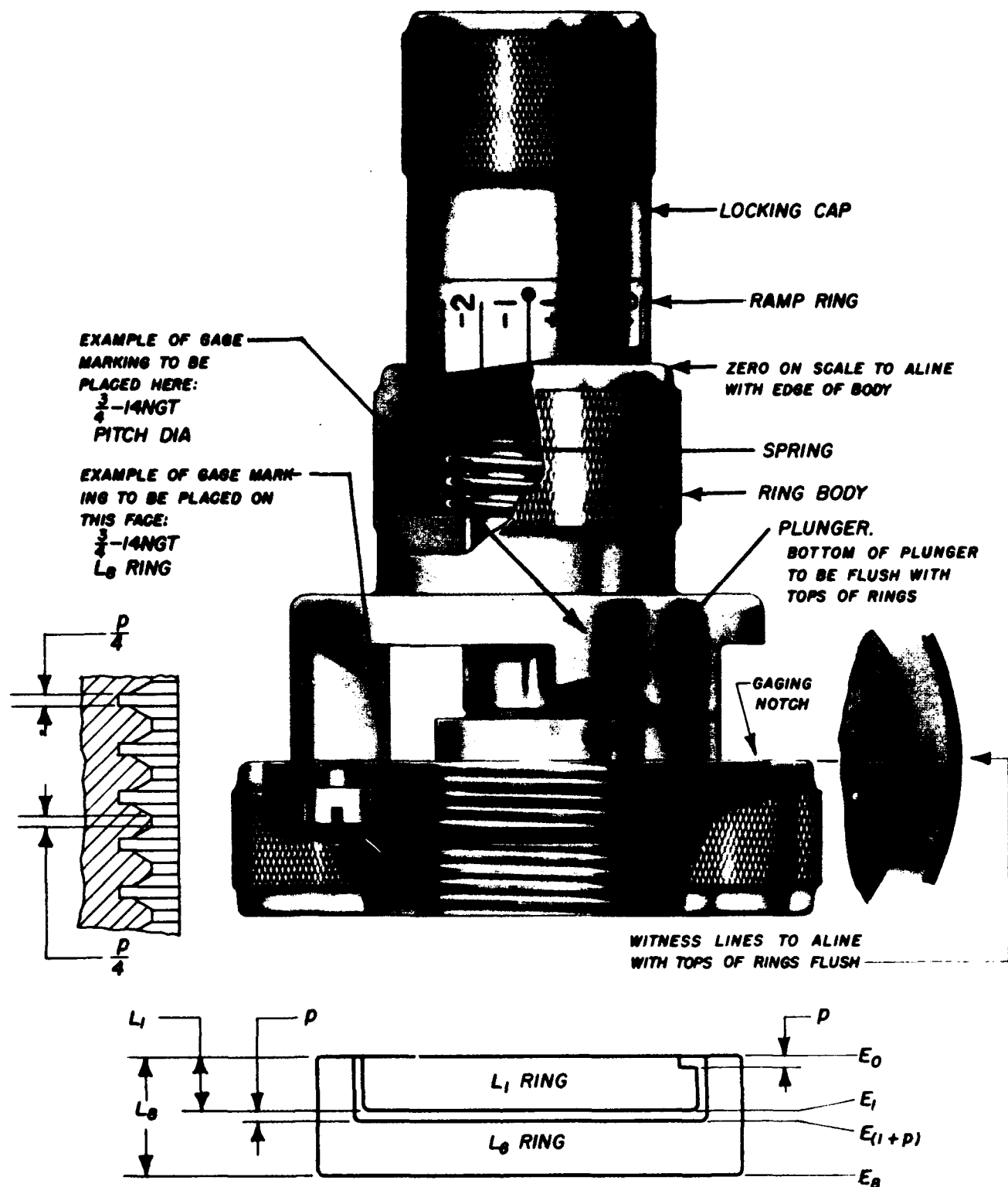


FIGURE IX.36.—Pitch diameter ring gages; NGT, SGT.

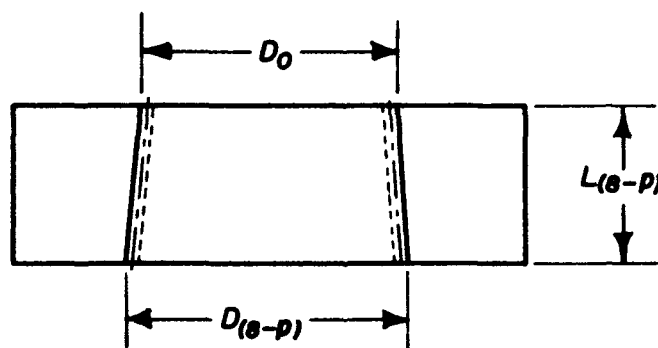
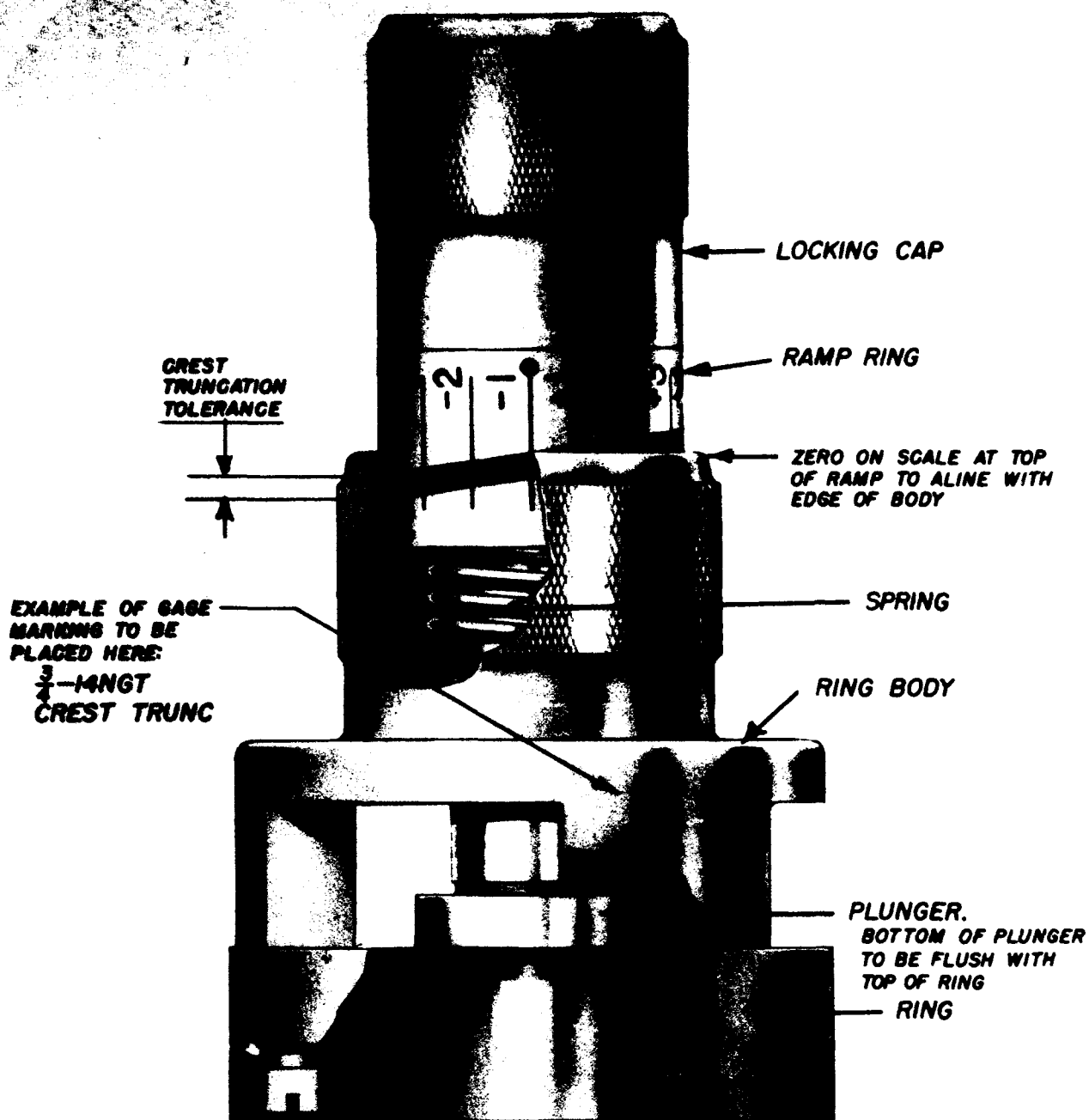


FIGURE IX.37.—Crest truncation ring gage: NGT, SGT.

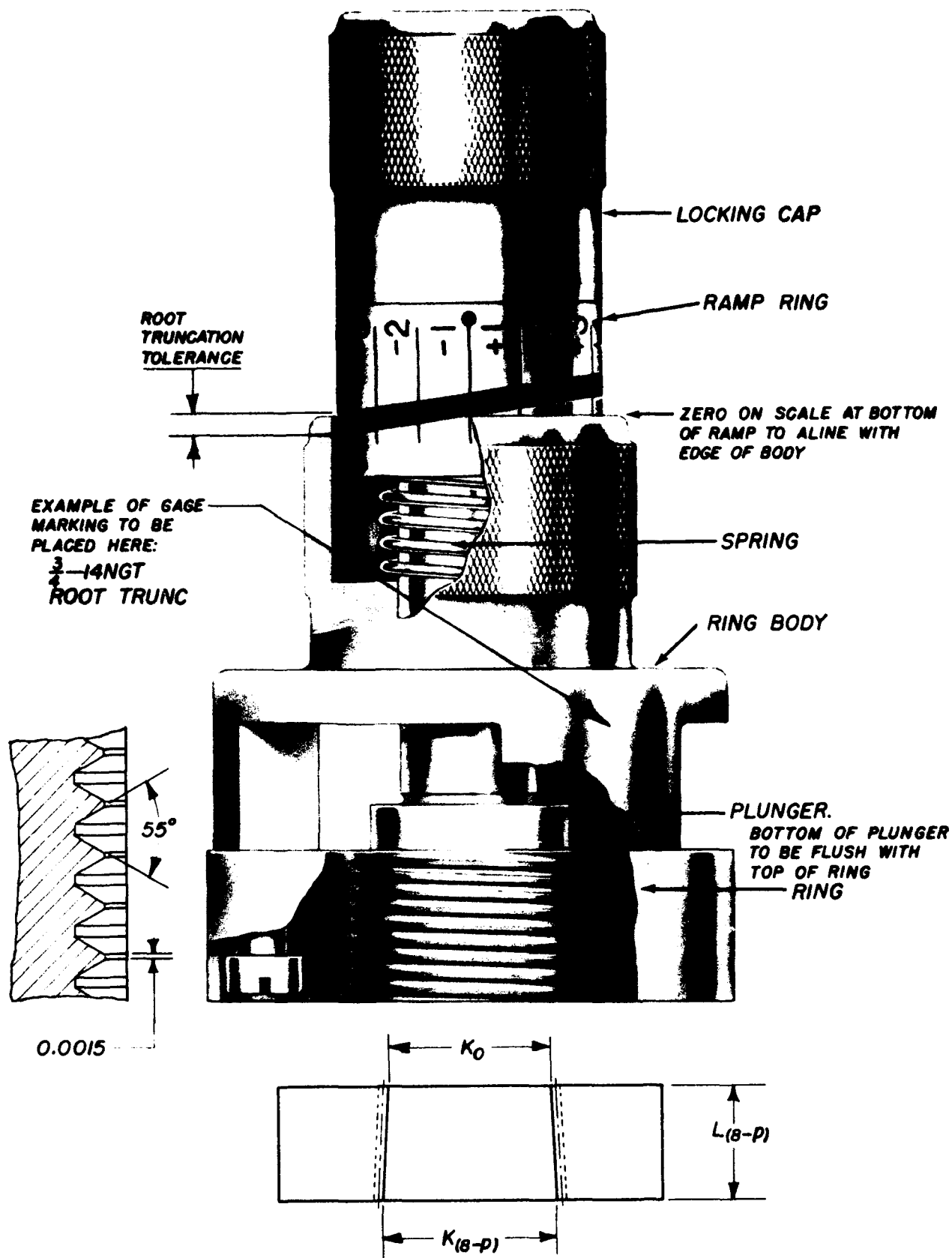


FIGURE IX.38. Root truncation ring gage; NGT, SGT.

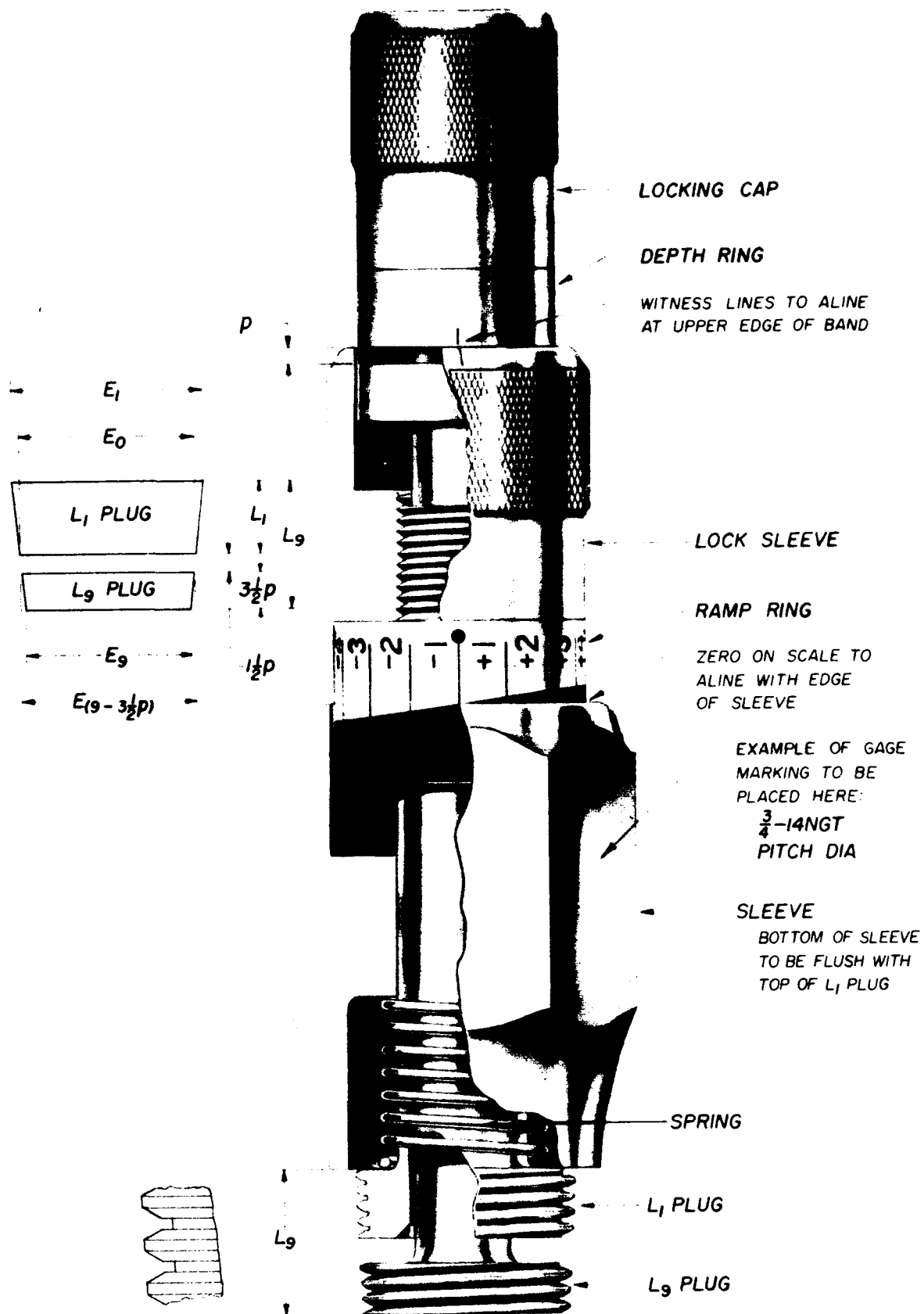


FIGURE IX.39.—Pitch diameter plug gage; NGT, SGT.

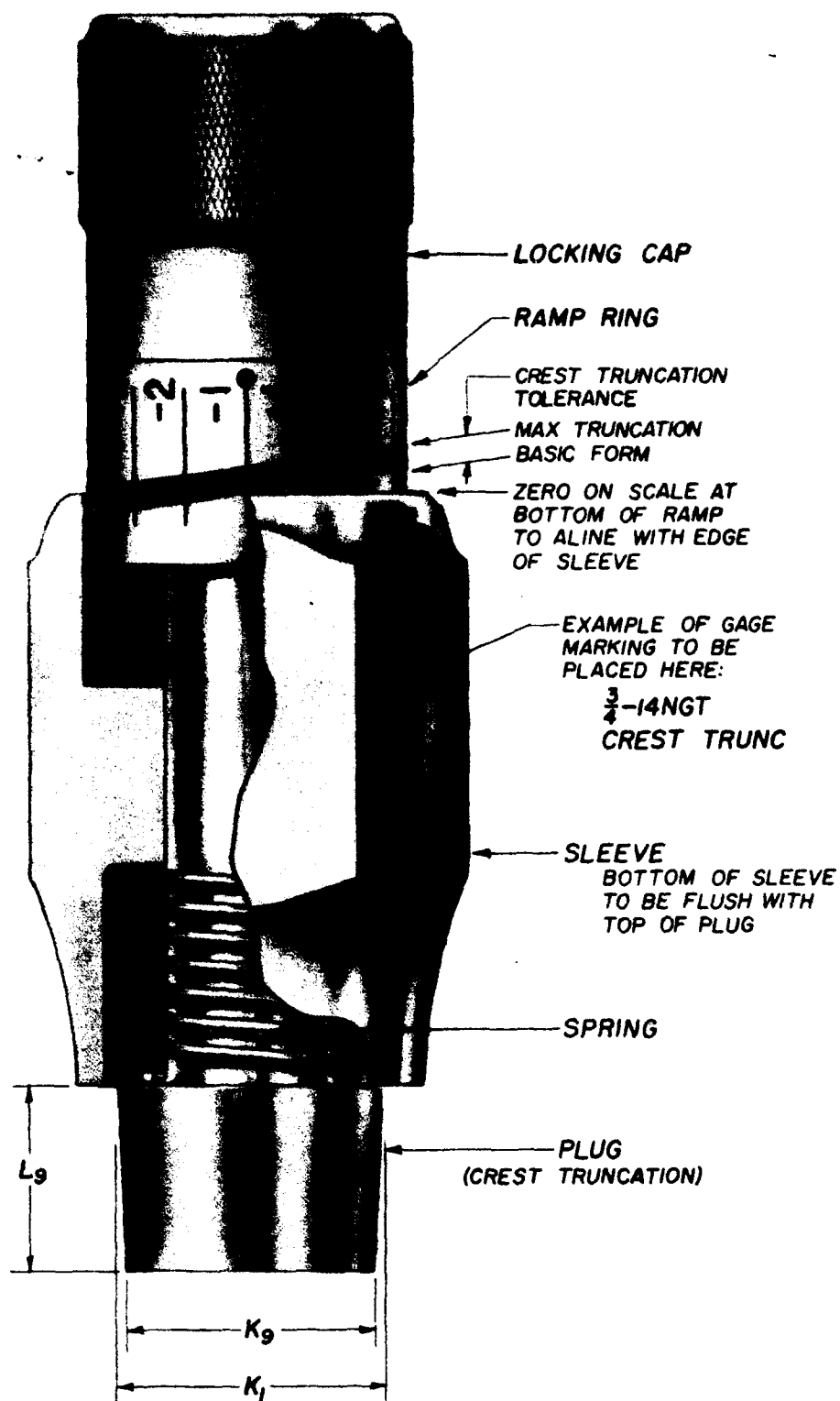


FIGURE IX.40.—Crest truncation plug gage; NGT, SGT.

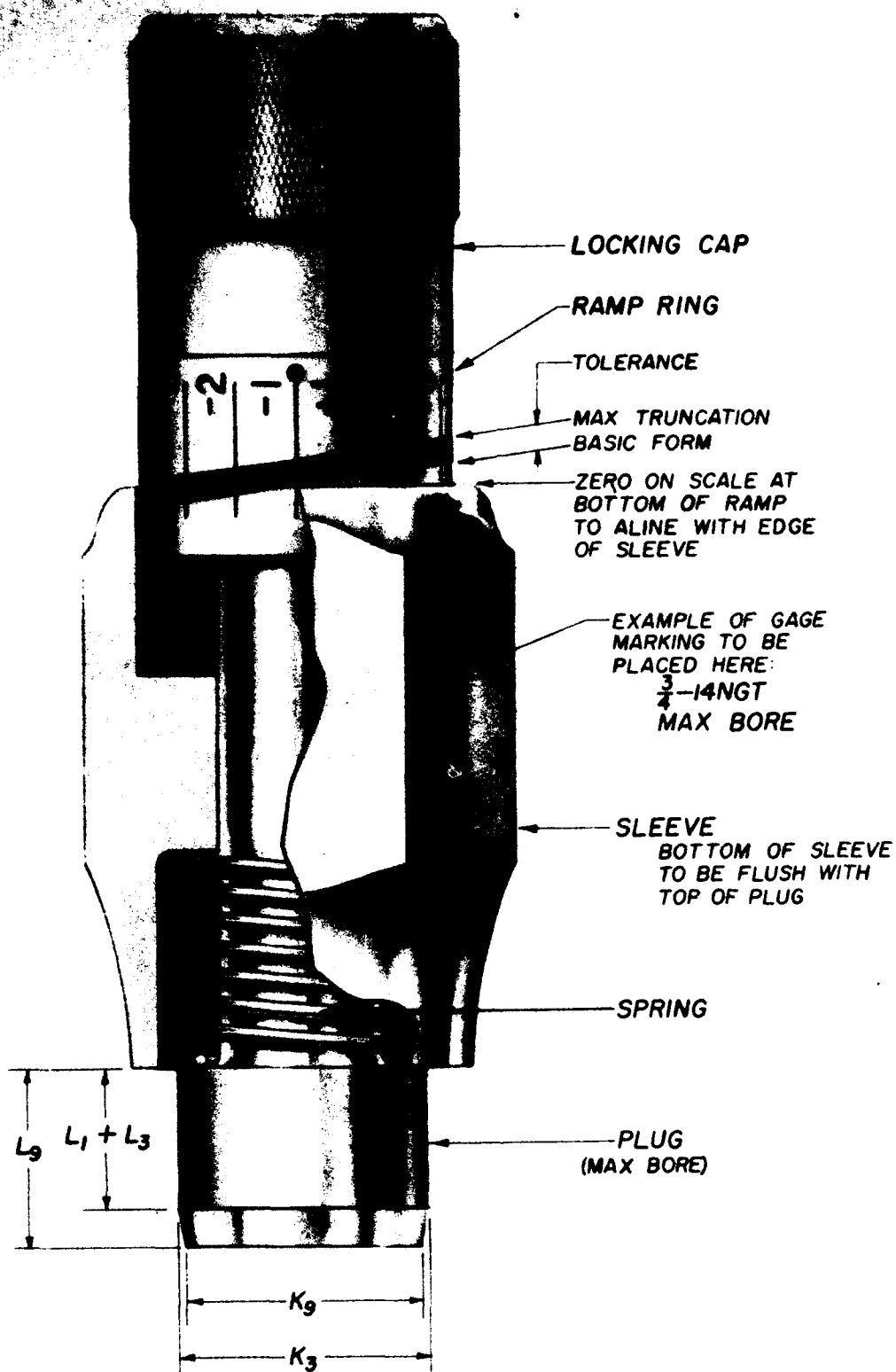


FIGURE IX.41.—Maximum bore plug gage; NGT, SGT.

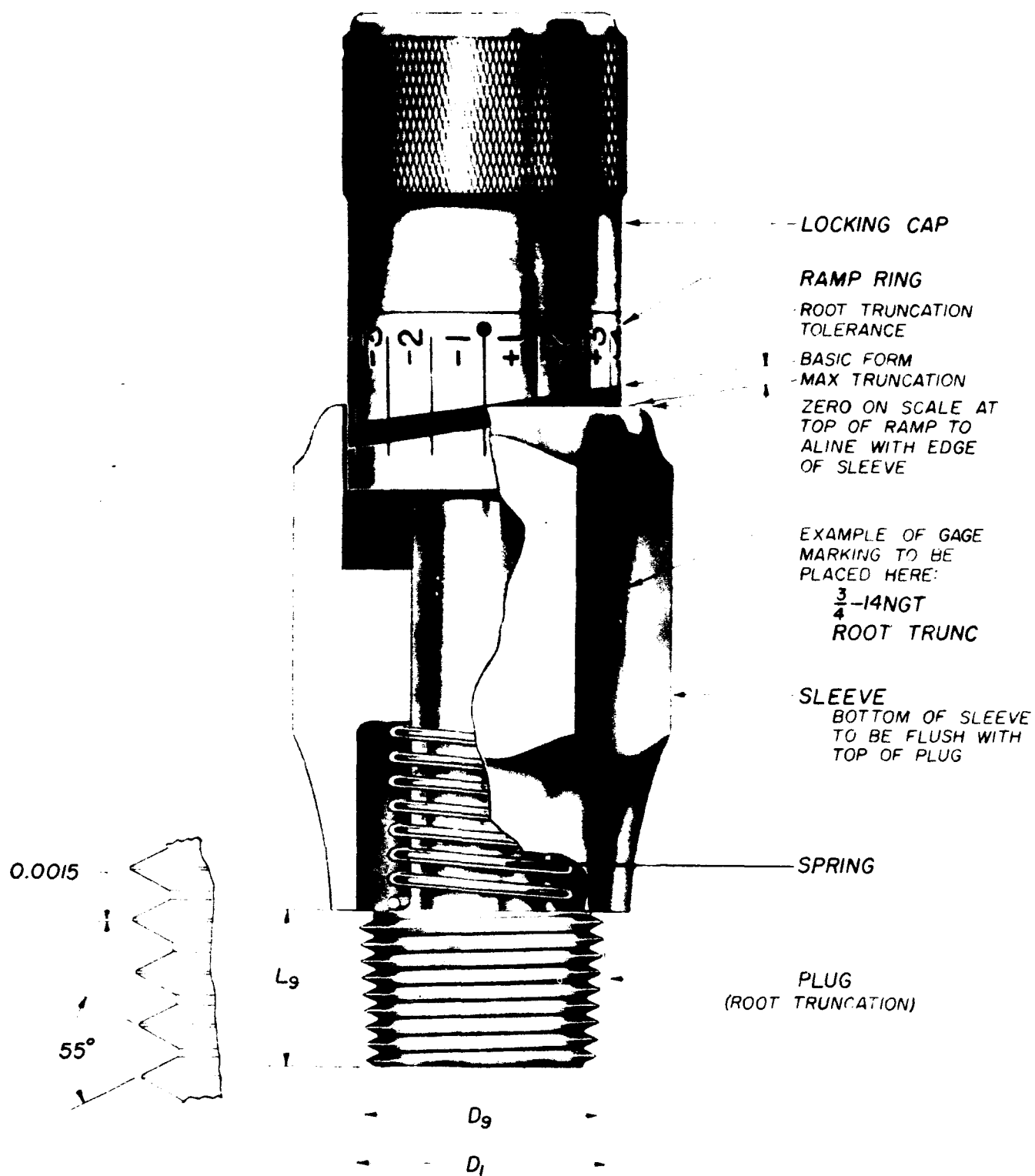
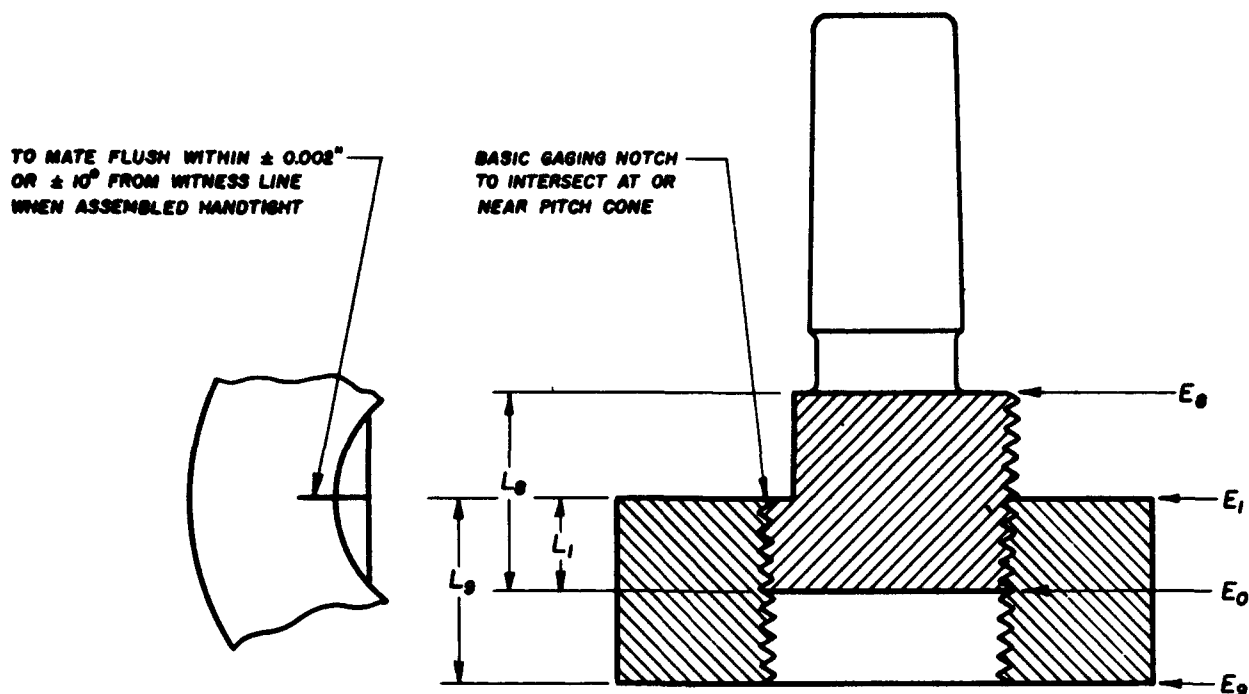
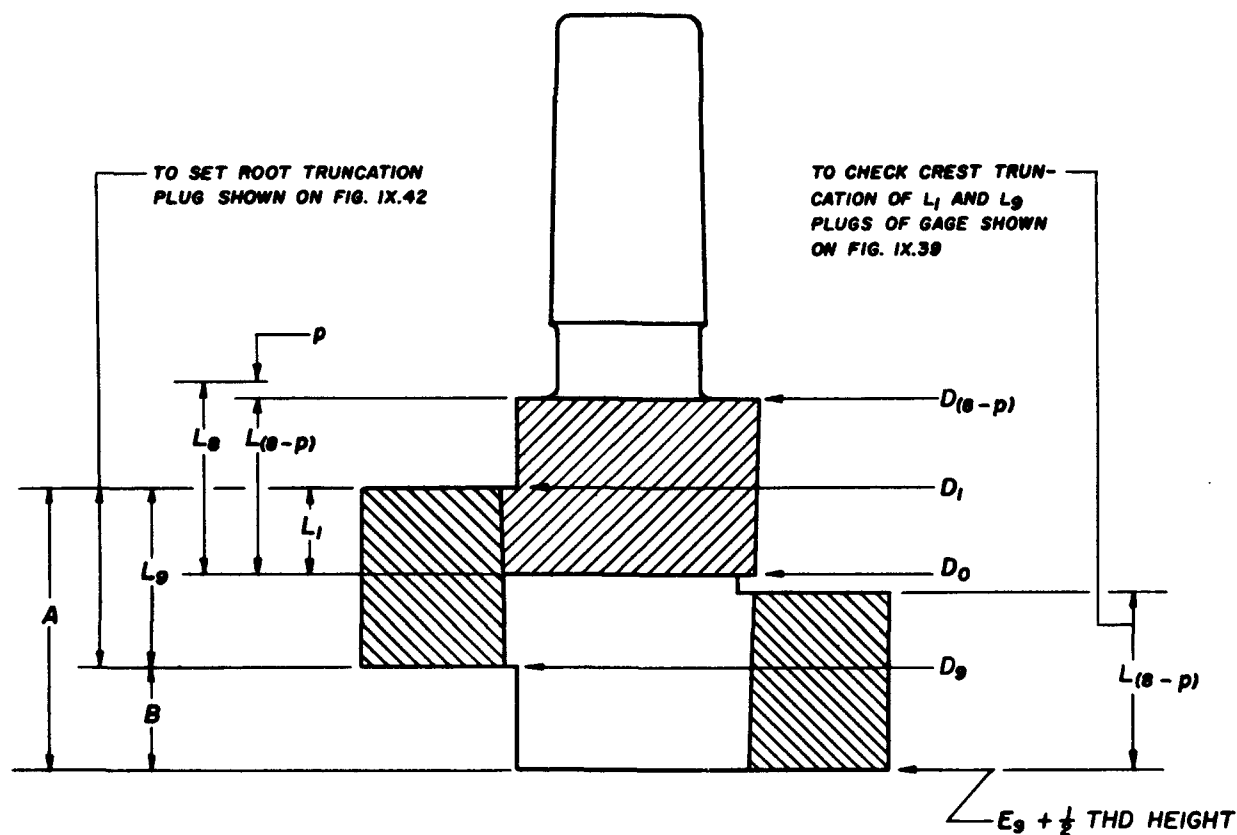


FIGURE IX.42.—Root truncation plug gage; NGT, SGT.



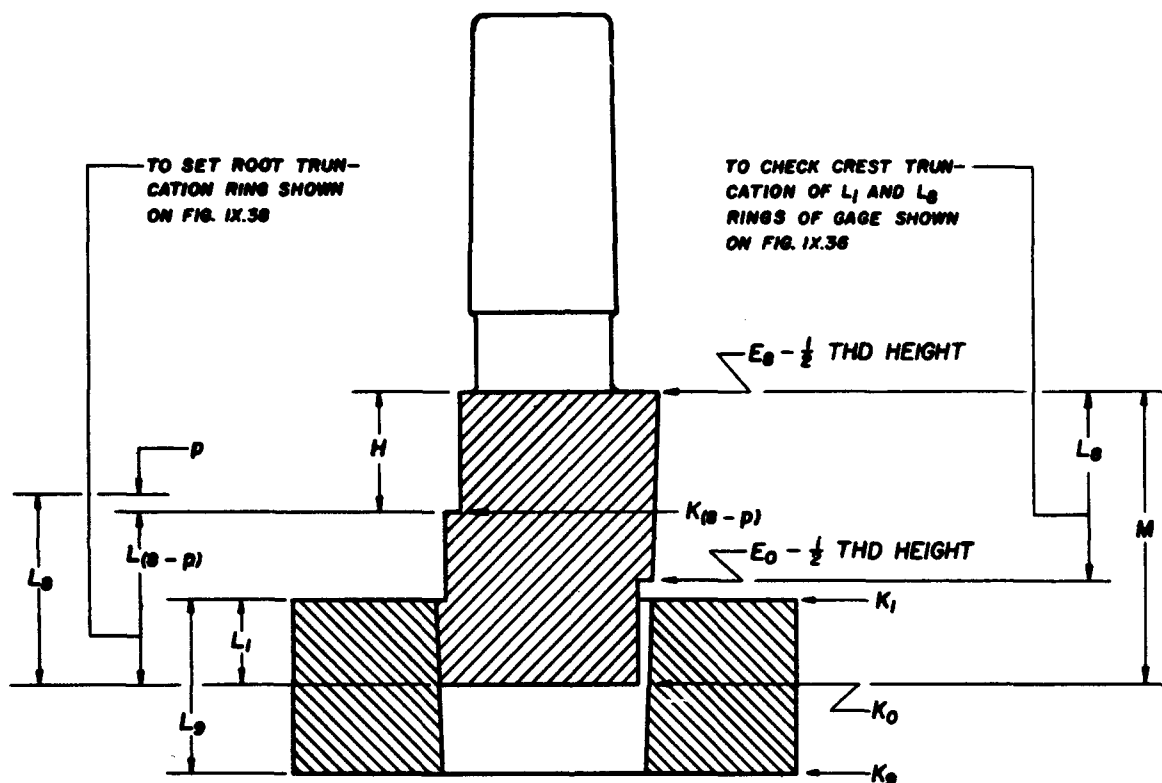
Roots of threads on plug and ring to be undercut to  $p/4$  max to clear sharp V  $60^\circ$  thread.  
 Gages to be calibrated to allow for deviations in flank angle, taper, lead, and pitch diameter. Maximum cumulative tolerance from true basic =  $1/16$  turn.  
 Master setting plug is for setting  $L_1$  and  $L_2$  ring gages shown on figure IX.36. Master setting ring is for setting  $L_1$  and  $L_2$  plug gages shown on figure IX.39  
 See tables IX.6 and IX.7 for dimensions, table IX.8 for tolerances.

FIGURE IX.43.—Master setting plug and ring gages for setting pitch diameter of threaded plug and ring gages; NGT, SGT.



Master setting plug is for setting crest truncation ring shown on figure IX.37. Master setting ring is for setting root truncation plug shown on figure IX.42  
 and to check crest truncation of  $L_1$  and  $L_2$  plugs of gage shown on figure IX.39.  
 See tables IX.6 and IX.7 for dimensions, table IX.8 for tolerances.

FIGURE IX.44.—Master setting plug and ring gages for setting and checking major diameters of plug and ring gages; NGT, SGT.



Master setting plug is for setting root truncation ring shown on figure IX.38 and to check crest truncation of  $L_1$  and  $L_2$  rings of gage shown on figure IX.36. Master setting ring is for setting crest truncation plug shown on figure IX.40 and maximum bore plug shown on figure IX.41. See tables IX.6 and IX.7 for dimensions, table IX.4 for tolerances.

FIGURE IX.45.—Master setting plug and ring gages for setting and checking minor diameters of plug and ring gages; NGT, SGT.

## SECTION X. AMERICAN NATIONAL HOSE COUPLING AND FIRE-HOSE COUPLING THREADS<sup>1</sup>

### 1. INTRODUCTION

1. AMERICAN NATIONAL HOSE COUPLING THREADS, NPSH.—The purpose of this specification is to provide a standard which will be recognized and adopted at once by a majority of manufacturers and consumers and toward which the minority may be brought, thus eliminating many threads which have been in use and the confusion and misunderstandings that have prevailed.

As in other lines of work, current practice in use and manufacture must be recognized as well as the specific advantages of certain thread proportions for specific uses. This prevents the adoption of a single specification for each one of the nominal sizes.

These standards apply to the threaded parts of hose couplings, valves, nozzles, and all other fittings used in direct connection with hose intended for fire protection or for domestic, industrial, and general service in nominal sizes of  $\frac{1}{2}$ ,  $\frac{3}{4}$ ,  $1$ ,  $1\frac{1}{4}$ ,  $1\frac{1}{2}$ , and  $2$  in. In Federal specification ZZ-H-466, Hose; Gasoline, Rubber-Metal, data are given on special hose coupling threads based on American National pipe threads, NPT, in nominal sizes of  $2\frac{1}{2}$ ,  $3$ ,  $3\frac{1}{2}$ , and  $4$  in., 8 threads per inch.

2. AMERICAN NATIONAL FIRE-HOSE COUPLING THREADS, NH.—Some years ago specifications for American National fire-hose coupling threads were approved by the National Board of Fire Underwriters, National Fire Protection Association, American Society of Mechanical Engineers, American Society of Municipal Improvements, New England Water Works Association, American Water Works Association, the National Bureau of Standards, and other interested organizations. These specifications were published in 1911 as the Specifications of the National Board of Fire Underwriters, recommended by the National Fire Protection Association and approved by the various other organizations. They were also published in 1914 as Circular C50 of the National Bureau of Standards. This circular was revised and republished in 1917.

When the National Screw Thread Commission took up its work on the standardization of screw threads, the specifications for fire-hose coupling threads above referred to were accepted as the basis of its work on fire-hose coupling threads. It was found, however, that the specifications as originally drawn were inadequate in that they specified nominal dimensions only, with no maximum and minimum limits. The limits of size herein specified have met with general approval

<sup>1</sup> This section, with the exception of table X.7, is substantially in agreement with the present issues of ASA B26, "National (American) Standard Fire-Hose Coupling Screw Thread," and ASA B33.1, "American Standard Hose Coupling Screw Threads," which are published by the ASME, 29 West 30th Street, New York 18, N.Y. The latest revisions should be consulted when referring to these ASA standards.

and correspond in all details with those recommended by the National Fire Protection Association and by the National Bureau of Standards.

3. THREADING TOOLS.—In ordering threading tools<sup>10</sup> for producing American National hose coupling and fire-hose coupling threads, it should be pointed out that new taps should be near the maximum permissible size of the coupling, and new dies near the minimum permissible size of the nipple, in order that reasonable wear may be provided. As the threading tools wear by use, the couplings will become smaller and the nipples larger until the limits of size are reached. These must not be exceeded. When the product reaches, or comes dangerously close to the limiting size, the threading tools should be readjusted or replaced.

### 2. FORM OF THREAD

Figure X.1 illustrates the thread form.

1. ANGLE OF THREAD.—The basic angle of thread,  $A$ , between the sides of the thread measured in an axial plane is  $60^\circ$ . The line bisecting this  $60^\circ$  angle, is perpendicular to the axis of the thread.

2. FLAT AT CREST AND ROOT.—The flat at the crest and root of the basic thread form is  $\frac{1}{8}p$  or  $0.125p$ .

3. HEIGHT OF THREAD.—The height of the basic thread form is

$$h = 0.649519p, \text{ or } h = \frac{0.649519}{n},$$

where

$p$  = pitch in inches,

$n$  = number of threads per inch,

$h$  = basic height of thread.

### 3. THREAD SERIES

1. AMERICAN NATIONAL HOSE COUPLING AND FIRE-HOSE COUPLING THREADS, NPSH AND NH.—In table X.1 are specified the basic dimensions of these threads. In tables X.2 and X.3 are specified the limits of size and tolerances. In tables X.4 and X.5 are specified the thread lengths and other thread details for these threads.

2. THREAD DESIGNATION.—These threads are designated by specifying in sequence the nominal size of hose, number of threads per inch, and the thread symbol as shown in the following examples:

$\frac{3}{4}$ —8NH  
 $1\frac{1}{4}$ —11 $\frac{1}{2}$ NPSH  
3—6NH  
6—4NH

<sup>10</sup> In the interest of the universal adoption of the American National fire-hose coupling threads throughout the United States, attention is directed to the fact that sets of tools for rethreading existing hydrants and hose couplings are commercially available. Such sets comprise roughing and finishing taps, roughing and finishing dies, expanders for expanding undersize externally threaded fittings preparatory to rethreading, gages, and various accessories. The tools are applicable where existing threaded fittings do not differ so widely from the American National threads as to leave insufficient stock for the new thread. By the use of such tools a considerable number of municipalities have at small expense converted their existing equipment and thus availed themselves of the important advantages which standardization

#### 4. TOLERANCES AND ALLOWANCES

The tolerances and allowances for the American National hose coupling and fire-hose coupling threads are specified in table X.6. The tolerances represent the extreme variations permitted on the threads. Figure X.1, below, shows the relationship between nipple and coupling dimensions, and thread form.

(a) The tolerance on the coupling (internal) thread is plus, and is applied from the minimum coupling dimension to above the minimum coupling dimension.

(b) The tolerance on the nipple (external) thread is minus, and is applied from the maximum nipple dimension to below the maximum nipple dimension.

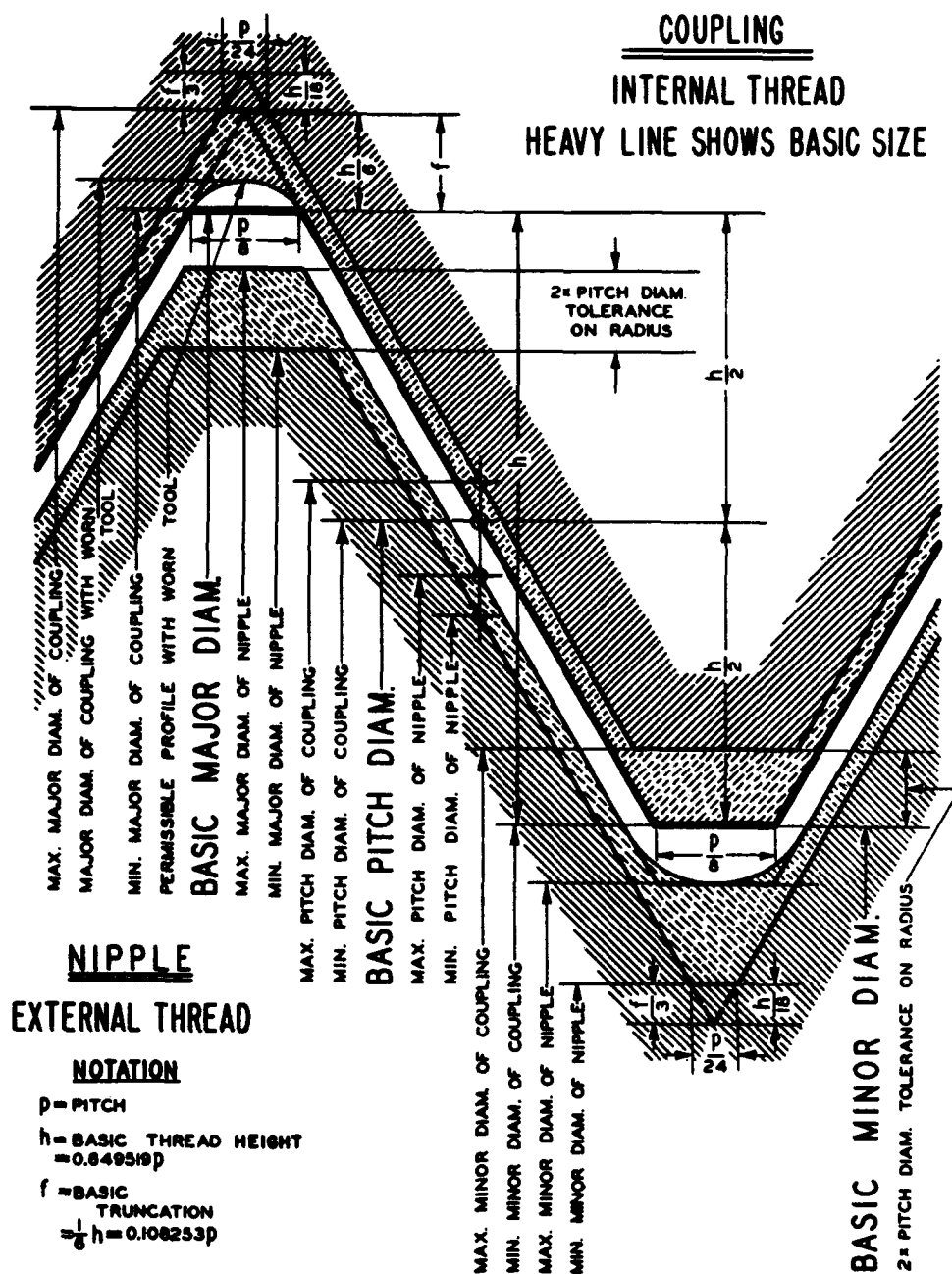


FIGURE X.1.—American National hose coupling and fire-hose coupling form of thread, NPSH and NH.

(c) The pitch diameter tolerances provided for a mating nipple and coupling are the same.

(d) Pitch diameter tolerances include lead and angle variations (see footnote a, table X.6).

(e) The tolerance on the major diameter is twice the tolerance on the pitch diameter.

(f) The tolerance on the minor diameter of the nipple (external) thread is equal to the tolerance on the pitch diameter plus two-ninths of the basic thread height. The minimum minor diameter of a nipple (external) thread is such as to result in a flat equal to one-third of the basic flat,  $p/24$ , at the root when the pitch diameter of the nipple (external) thread is at its minimum value. The maximum minor diameter is basic, but may be such as results from the use of a worn or rounded threading tool.

(g) The tolerance on the major diameter of the coupling (internal) thread is equal to the tolerance on the pitch diameter plus two-ninths of the basic thread height. The minimum major diameter of the coupling (internal) thread is such as to result in a basic flat,  $p/8$ , when the pitch diameter of the coupling is at its minimum value. The maximum major diameter of the coupling is that corresponding to a flat equal to one-third the basic flat,  $p/24$ .

(h) The tolerance on the minor diameter of the coupling (internal) thread is twice the tolerance on the pitch diameter of the coupling. The minimum minor diameter of a coupling is such as to result in a basic flat,  $p/8$ , at the crest when the pitch diameter of the coupling is at its minimum value.

## 5. GAGES

1. GAGES FOR AMERICAN NATIONAL HOSE COUPLING THREADS.—Limits of size of gages for American National hose coupling threads are given in table X.7 and are based on the specifications and tolerances for gages given in section VI of part I.

2. GAGES FOR AMERICAN NATIONAL FIRE-HOSE COUPLING THREADS.—It is recommended that American National fire-hose coupling threads be inspected in the field by means of gages made within the tolerances given in table X.8. Limits of size for these gages are given in tables X.9 and X.10.

It is further recommended that American National fire-hose coupling threads be given final inspection by the manufacturer by means of gages made within the limits given in tables X.9 and X.10 in order to avoid, as far as possible, disagreements which might otherwise arise as the result of slight differences in the sizes of gages.

## 6. EXTENT OF USAGE OF THE AMERICAN NATIONAL FIRE-HOSE COUPLING THREADS

In appendix 9 is a listing of the cities in the United States which had a population of 25,000 or more in accordance with the 1950 census, and which have not standardized on the American National fire-hose coupling threads on hydrants, couplings, and nipples used with 2½ in. nominal size fire hose.

TABLE X.1.—Basic dimensions of American National hose coupling and fire-hose coupling threads, NPSH and NH

| Nominal size of hose | Symbol  | Service                                                                                     | Thds per inch | Pitch      | Height of thread | Maximum nipple dimensions (external thread) |                |                |                | Minimum (basic) coupling dimensions (internal thread) |                |                |
|----------------------|---------|---------------------------------------------------------------------------------------------|---------------|------------|------------------|---------------------------------------------|----------------|----------------|----------------|-------------------------------------------------------|----------------|----------------|
|                      |         |                                                                                             |               |            |                  | Allowance                                   | Major diameter | Pitch diameter | Minor diameter | Minor diameter                                        | Pitch diameter | Major diameter |
| 1                    | 2       | 3                                                                                           | 4             | 5          | 6                | 7                                           | 8              | 9              | 10             | 11                                                    | 12             | 13             |
| <i>in.</i>           |         |                                                                                             |               | <i>in.</i> | <i>in.</i>       | <i>in.</i>                                  | <i>in.</i>     | <i>in.</i>     | <i>in.</i>     | <i>in.</i>                                            | <i>in.</i>     | <i>in.</i>     |
| ½, ¾, 1              | NH      | Garden hose                                                                                 | 11½           | 0.08666    | 0.05648          | 0.0100                                      | 1.0625         | 1.0080         | 0.9495         | 0.9595                                                | 1.0160         | 1.0725         |
| ¾, 1                 | NH      | Chemical engine and booster hose                                                            | 8             | .12500     | .08119           | .0120                                       | 1.3750         | 1.2938         | 1.2126         | 1.2246                                                | 1.3058         | 1.3870         |
| 1½                   | NH      | Fire hose                                                                                   | 9             | .11111     | .07217           | .0120                                       | 1.9900         | 1.9178         | 1.8457         | 1.8577                                                | 1.9298         | 2.0020         |
| 1½                   | NPSH    | Steam, air, water, and all other hose connections to be made up with standard pipe threads. | 14            | .07143     | .04639           | .0075                                       | .8248          | .7784          | .7320          | .7395                                                 | .7859          | .8323          |
| ¾                    | NPSH    |                                                                                             | 14            | .07143     | .04639           | .0075                                       | 1.0353         | .9889          | .9425          | .9500                                                 | .9964          | 1.0428         |
| 1                    | NPSH    |                                                                                             | 11½           | .08666     | .05648           | .0100                                       | 1.2951         | 1.2386         | 1.1821         | 1.1921                                                | 1.2486         | 1.3051         |
| 1¼                   | NPSH    |                                                                                             | 11¼           | .08666     | .05648           | .0100                                       | 1.6399         | 1.5834         | 1.5269         | 1.5369                                                | 1.5934         | 1.6499         |
| 1½                   | NPSH    |                                                                                             | 11¼           | .08666     | .05648           | .0100                                       | 1.8788         | 1.8223         | 1.7658         | 1.7758                                                | 1.8323         | 1.8888         |
| 2                    | NPSH    |                                                                                             | 11¼           | .08666     | .05648           | .0100                                       | 2.3528         | 2.2963         | 2.2398         | 2.2498                                                | 2.3063         | 2.3628         |
| 2½                   | NH      | Fire hose                                                                                   | 7½            | .13333     | .08600           | .0150                                       | 3.0686         | 2.9820         | 2.8954         | 2.9104                                                | 2.9970         | 3.0836         |
| 3                    | NH      |                                                                                             | 6             | .16667     | .10625           | .0150                                       | 3.6239         | 3.5156         | 3.4073         | 3.4223                                                | 3.5306         | 3.6389         |
| 3½                   | NH      |                                                                                             | 6             | .16667     | .10625           | .0200                                       | 4.2439         | 4.1356         | 4.0273         | 4.0473                                                | 4.1556         | 4.2639         |
| 4                    | NH(SPL) |                                                                                             | 6             | .16667     | .10625           | .0201                                       | 4.9082         | 4.7999         | 4.6916         | 4.7117                                                | 4.8200         | 4.9283         |
| 4                    | NH      |                                                                                             | 4             | .25000     | .16238           | .0250                                       | 5.0109         | 4.8485         | 4.6861         | 4.7111                                                | 4.8735         | 5.0359         |
| 4½                   | NH      |                                                                                             | 4             | .25000     | .16238           | .0250                                       | 5.7609         | 5.5985         | 5.4361         | 5.4611                                                | 5.6235         | 5.7859         |
| 5                    | NH      |                                                                                             | 4             | .25000     | .16238           | .0250                                       | 6.2600         | 6.0976         | 5.9352         | 5.9602                                                | 6.1226         | 6.2850         |
| 6                    | NH      |                                                                                             | 4             | .25000     | .16238           | .0250                                       | 7.0250         | 6.8626         | 6.7002         | 6.7252                                                | 6.8876         | 7.0500         |

\* Data on the 4-6NH(SPL) thread are included since this thread is used extensively\* aboard ship by the Navy Department.

**TABLE X.2.—Limits of size and tolerances for American National hose coupling and fire-hose coupling external threads, NPSH and NH nipples**

| Nominal size of hose                              | Symbol  | Service                                                                                     | Thds per inch | Pitch  | Height of thread | Nipple (external) thread |        |       |                |        |        |                |
|---------------------------------------------------|---------|---------------------------------------------------------------------------------------------|---------------|--------|------------------|--------------------------|--------|-------|----------------|--------|--------|----------------|
|                                                   |         |                                                                                             |               |        |                  | Major diameter           |        |       | Pitch diameter |        |        | Minor diameter |
|                                                   |         |                                                                                             |               |        |                  | Max                      | Min    | Tol.  | Max            | Min    | Tol.   |                |
| 1                                                 | 2       | 3                                                                                           | 4             | 5      | 6                | 7                        | 8      | 9     | 10             | 11     | 12     | 13             |
| $\frac{1}{4}$ , $\frac{3}{8}$ , $\frac{1}{2}$ in. | NH      | Garden hose                                                                                 | 11½           | in.    | in.              | in.                      | in.    | in.   | in.            | in.    | in.    | in.            |
| $\frac{3}{8}$ , 1                                 | NH      | Chemical engine and booster hose                                                            | 8             | .12500 | .08119           | 1.0625                   | 1.0455 | .0170 | 1.0090         | 0.9975 | 0.0085 | 0.9495         |
| $\frac{1}{4}$                                     | NH      | Fire hose                                                                                   | 9             | .11111 | .07217           | 1.9900                   | 1.9678 | .0222 | 1.9178         | 1.9057 | .0111  | 1.8457         |
| $\frac{3}{8}$                                     | NPSH    | Steam, air, water, and all other hose connections to be made up with standard pipe threads. | 14            | .07143 | .04639           | .8248                    | .8108  | .0140 | .7784          | .7714  | .0070  | .7920          |
| $\frac{1}{2}$                                     | NPSH    |                                                                                             | 14            | .07143 | .04639           | 1.0353                   | 1.0213 | .0140 | .9989          | .9819  | .0070  | .9425          |
| 1                                                 | NPSH    |                                                                                             | 11½           | .08996 | .05648           | 1.2651                   | 1.2781 | .0170 | 1.2386         | 1.2301 | .0085  | 1.1821         |
| $\frac{1}{4}$                                     | NPSH    |                                                                                             | 11½           | .08996 | .05648           | 1.6399                   | 1.6239 | .0170 | 1.5834         | 1.5749 | .0085  | 1.5329         |
| $\frac{3}{8}$                                     | NPSH    |                                                                                             | 11½           | .08996 | .05648           | 1.8788                   | 1.8618 | .0170 | 1.8223         | 1.8138 | .0085  | 1.7648         |
| 2                                                 | NPSH    |                                                                                             | 11½           | .08996 | .05648           | 2.3528                   | 2.3358 | .0170 | 2.2963         | 2.2878 | .0085  | 2.2398         |
| $\frac{3}{4}$                                     | NH      | Fire hose                                                                                   | 7½            | .13333 | .08990           | 3.0986                   | 3.0966 | .0020 | 2.9820         | 2.9800 | .0180  | 2.8964         |
| 3                                                 | NH      |                                                                                             | 6             | .16667 | .10825           | 3.6289                   | 3.6279 | .0010 | 3.5156         | 3.4976 | .0180  | 3.4078         |
| $\frac{3}{8}$                                     | NH      |                                                                                             | 6             | .16667 | .10825           | 4.2489                   | 4.2079 | .0060 | 4.1356         | 4.1176 | .0180  | 4.0278         |
| $\frac{1}{2}$                                     | NH(SPL) |                                                                                             | 6             | .16667 | .10825           | 4.9082                   | 4.8722 | .0060 | 4.7949         | 4.7819 | .0180  | 4.6916         |
| 4                                                 | NH      |                                                                                             | 4             | .25000 | .16238           | 5.0109                   | 4.9809 | .0060 | 4.8485         | 4.8285 | .0260  | 4.6961         |
| $\frac{1}{4}$                                     | NH      |                                                                                             | 4             | .25000 | .16238           | 5.7809                   | 5.7109 | .0060 | 5.5985         | 5.5785 | .0260  | 5.4361         |
| $\frac{3}{8}$                                     | NH      |                                                                                             | 4             | .25000 | .16238           | 6.2800                   | 6.2100 | .0060 | 6.0976         | 6.0726 | .0260  | 5.9852         |
| 6                                                 | NH      |                                                                                             | 4             | .25000 | .16238           | 7.0250                   | 6.9750 | .0500 | 6.8626         | 6.8376 | .0260  | 6.7002         |

\* Dimensions given for the maximum minor diameter of the nipple are figured to the intersection of the worn tool are with a centerline through crest and root. The minimum minor diameter of the nipple shall be that corresponding to a flat at the minor diameter of the minimum nipple equal to  $\frac{1}{4} \times p$ .

and may be determined by subtracting  $1\frac{1}{4} \times A$  (or 0.7939p) from the minimum pitch diameter of the nipple.

\* Data on the 4-6NH(SPL) thread are included since this thread is used extensively by the Navy Department.

**TABLE X.3.—Limits of size and tolerances for American National hose coupling and fire-hose coupling internal threads, NPSH and NH couplings**

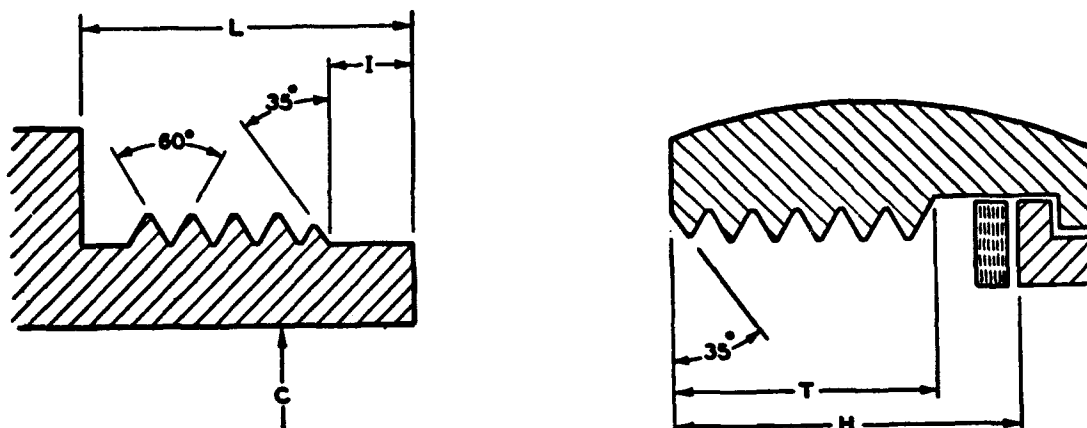
| Nominal size of hose                              | Symbol  | Service                                                                                     | Thds per inch | Pitch  | Height of thread | Coupling (internal) thread |        |       |                |        |       |                |
|---------------------------------------------------|---------|---------------------------------------------------------------------------------------------|---------------|--------|------------------|----------------------------|--------|-------|----------------|--------|-------|----------------|
|                                                   |         |                                                                                             |               |        |                  | Minor diameter             |        |       | Pitch diameter |        |       | Major diameter |
|                                                   |         |                                                                                             |               |        |                  | Min                        | Max    | Tol.  | Min            | Max    | Tol.  |                |
| 1                                                 | 2       | 3                                                                                           | 4             | 5      | 6                | 7                          | 8      | 9     | 10             | 11     | 12    | 13             |
| $\frac{1}{4}$ , $\frac{3}{8}$ , $\frac{1}{2}$ in. | NH      | Garden hose                                                                                 | 11½           | in.    | in.              | in.                        | in.    | in.   | in.            | in.    | in.   | in.            |
| $\frac{3}{8}$ , 1                                 | NH      | Chemical engine and booster hose                                                            | 8             | .12500 | .08119           | 1.2248                     | 1.2468 | .0222 | 1.3058         | 1.3169 | .0111 | 1.3870         |
| $\frac{1}{4}$                                     | NH      | Fire hose                                                                                   | 9             | .11111 | .07217           | 1.8577                     | 1.8799 | .0222 | 1.9298         | 1.9409 | .0111 | 2.0020         |
| $\frac{3}{8}$                                     | NPSH    | Steam, air, water, and all other hose connections to be made up with standard pipe threads. | 14            | .07143 | .04639           | .7395                      | .7535  | .0140 | .7869          | .7929  | .0070 | .8323          |
| $\frac{1}{2}$                                     | NPSH    |                                                                                             | 14            | .07143 | .04639           | .9500                      | .9640  | .0140 | .9964          | 1.0034 | .0070 | 1.0428         |
| 1                                                 | NPSH    |                                                                                             | 11½           | .08996 | .05648           | 1.1921                     | 1.2081 | .0170 | 1.2486         | 1.2571 | .0085 | 1.3051         |
| $\frac{1}{4}$                                     | NPSH    |                                                                                             | 11½           | .08996 | .05648           | 1.5369                     | 1.5539 | .0170 | 1.5934         | 1.6019 | .0085 | 1.6499         |
| $\frac{3}{8}$                                     | NPSH    |                                                                                             | 11½           | .08996 | .05648           | 1.7758                     | 1.7928 | .0170 | 1.8323         | 1.8408 | .0085 | 1.8888         |
| 2                                                 | NPSH    |                                                                                             | 11½           | .08996 | .05648           | 2.2498                     | 2.2668 | .0170 | 2.3063         | 2.3148 | .0085 | 2.3628         |
| $\frac{3}{4}$                                     | NH      | Fire hose                                                                                   | 7½            | .13333 | .08990           | 2.9104                     | 2.9424 | .0320 | 2.9970         | 3.0130 | .0160 | 3.0636         |
| 3                                                 | NH      |                                                                                             | 6             | .16667 | .10825           | 3.4223                     | 3.4563 | .0060 | 3.5306         | 3.5486 | .0180 | 3.6389         |
| $\frac{3}{8}$                                     | NH      |                                                                                             | 6             | .16667 | .10825           | 4.0473                     | 4.0833 | .0060 | 4.1556         | 4.1736 | .0180 | 4.2639         |
| $\frac{1}{2}$                                     | NH(SPL) |                                                                                             | 6             | .16667 | .10825           | 4.7117                     | 4.7477 | .0060 | 4.8200         | 4.8380 | .0180 | 4.9283         |
| 4                                                 | NH      |                                                                                             | 4             | .25000 | .16238           | 4.7111                     | 4.7611 | .0500 | 4.8735         | 4.8985 | .0260 | 5.0359         |
| $\frac{1}{4}$                                     | NH      |                                                                                             | 4             | .25000 | .16238           | 5.4611                     | 5.5111 | .0500 | 5.6235         | 5.6485 | .0260 | 5.7859         |
| $\frac{3}{8}$                                     | NH      |                                                                                             | 4             | .25000 | .16238           | 5.9602                     | 6.0102 | .0500 | 6.1226         | 6.1476 | .0260 | 6.2850         |
| 6                                                 | NH      |                                                                                             | 4             | .25000 | .16238           | 6.7252                     | 6.7752 | .0500 | 6.8876         | 6.9126 | .0260 | 7.0600         |

\* Dimensions for the minimum major diameter of the coupling correspond to the basic flat ( $\frac{1}{4} \times p$ ), and the profile at the major diameter produced by a worn tool must not fall below the basic outline. The maximum major diameter of the coupling shall be that corresponding to a flat at the major

diameter of the maximum coupling equal to  $\frac{1}{4} \times p$ , and may be determined by adding  $1\frac{1}{4} \times A$  (or 0.7939p) to the maximum pitch diameter of the coupling.

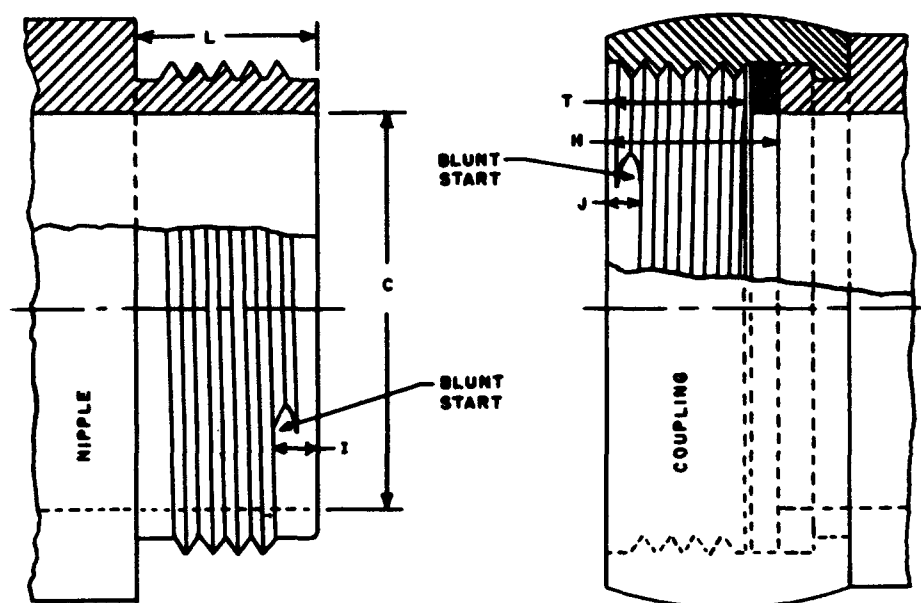
\* Data on the 4-6NH(SPL) thread are included since this thread is used extensively by the Navy Department.

TABLE X.4.—Lengths of threads for American National hose coupling threads, NPSH (all sizes), and for American National fire-hose coupling threads, NH (up to and including the 1 inch size)



| Nominal size of hose                          | Symbol | Service                                                                                     | Threads per inch, <i>n</i> | Inside diameter of nipple, <i>C</i> | Approximate outside diameter of external thread | Length of nipple, <i>L</i> | Length of pilot, <i>I</i> | Depth of coupling, <i>H</i> | Thread length for coupling, <i>T</i> | Approximate number of threads in length, <i>T</i> |
|-----------------------------------------------|--------|---------------------------------------------------------------------------------------------|----------------------------|-------------------------------------|-------------------------------------------------|----------------------------|---------------------------|-----------------------------|--------------------------------------|---------------------------------------------------|
| 1                                             | 2      | 3                                                                                           | 4                          | 5                                   | 6                                               | 7                          | 8                         | 9                           | 10                                   | 11                                                |
| <i>in.</i>                                    |        |                                                                                             |                            | <i>in.</i>                          | <i>in.</i>                                      | <i>in.</i>                 | <i>in.</i>                | <i>in.</i>                  | <i>in.</i>                           |                                                   |
| $\frac{1}{2}$ , $\frac{3}{4}$ , $\frac{1}{2}$ | NH     | Garden hose                                                                                 | 11 $\frac{1}{2}$           | 2 $\frac{5}{32}$                    | 1 $\frac{1}{16}$                                | $\frac{9}{16}$             | $\frac{1}{8}$             | 1 $\frac{7}{32}$            | $\frac{3}{8}$                        | 4 $\frac{1}{4}$                                   |
| $\frac{3}{4}$ , 1                             | NH     | Chemical engine and booster hose.                                                           | 8                          | 1 $\frac{1}{32}$                    | 1 $\frac{3}{8}$                                 | $\frac{5}{8}$              | $\frac{5}{32}$            | 1 $\frac{9}{32}$            | 1 $\frac{5}{32}$                     | 3 $\frac{3}{4}$                                   |
| $\frac{1}{2}$                                 | NPSH   | Steam, air, water, and all other hose connections to be made up with standard pipe threads. | 14                         | 1 $\frac{7}{32}$                    | 1 $\frac{3}{16}$                                | $\frac{1}{2}$              | $\frac{1}{8}$             | 1 $\frac{5}{32}$            | $\frac{5}{16}$                       | 4 $\frac{1}{4}$                                   |
| $\frac{3}{4}$                                 | NPSH   |                                                                                             | 14                         | 2 $\frac{5}{32}$                    | 1 $\frac{1}{2}$                                 | $\frac{9}{16}$             | $\frac{1}{8}$             | 1 $\frac{7}{32}$            | $\frac{3}{8}$                        | 5 $\frac{1}{4}$                                   |
| 1                                             | NPSH   |                                                                                             | 11 $\frac{1}{2}$           | 1 $\frac{1}{32}$                    | 1 $\frac{9}{32}$                                | $\frac{9}{16}$             | $\frac{5}{32}$            | 1 $\frac{7}{32}$            | $\frac{3}{8}$                        | 4 $\frac{1}{4}$                                   |
| 1 $\frac{1}{4}$                               | NPSH   |                                                                                             | 11 $\frac{1}{2}$           | 1 $\frac{9}{32}$                    | 1 $\frac{5}{8}$                                 | $\frac{5}{8}$              | $\frac{5}{32}$            | 1 $\frac{9}{32}$            | 1 $\frac{3}{32}$                     | 5 $\frac{1}{2}$                                   |
| 1 $\frac{3}{4}$                               | NPSH   |                                                                                             | 11 $\frac{1}{2}$           | 1 $\frac{17}{32}$                   | 1 $\frac{7}{8}$                                 | $\frac{5}{8}$              | $\frac{5}{32}$            | 1 $\frac{9}{32}$            | 1 $\frac{5}{32}$                     | 5 $\frac{1}{2}$                                   |
| 2                                             | NPSH   |                                                                                             | 11 $\frac{1}{2}$           | 2 $\frac{1}{32}$                    | 2 $\frac{1}{16}$                                | $\frac{3}{4}$              | $\frac{3}{16}$            | 2 $\frac{1}{32}$            | 1 $\frac{9}{32}$                     | 6 $\frac{3}{4}$                                   |

TABLE X.5.—Lengths of threads for American National fire-hose coupling threads, NH (1½ in. size and larger)



| Nominal size of hose | Symbol  | Service   | Threads per inch, <i>n</i> | Inside diameter of nipple or coupling, <i>C</i> | Approximate outside diameter of external thread | Length of nipple, <i>L</i> | Length of pilot to start of second thread, <i>I</i> | Depth of coupling, <i>H</i> | Thread length for coupling, <i>T</i> | From face of coupling to start of second thread, <i>J</i> |
|----------------------|---------|-----------|----------------------------|-------------------------------------------------|-------------------------------------------------|----------------------------|-----------------------------------------------------|-----------------------------|--------------------------------------|-----------------------------------------------------------|
| 1                    | 2       | 3         | 4                          | 5                                               | 6                                               | 7                          | 8                                                   | 9                           | 10                                   | 11                                                        |
| <i>in.</i>           |         |           |                            | <i>in.</i>                                      | <i>in.</i>                                      | <i>in.</i>                 | <i>in.</i>                                          | <i>in.</i>                  | <i>in.</i>                           | <i>in.</i>                                                |
| 1½                   | NH      | Fire hose | 9                          | 1½                                              | 2                                               | 5/8                        | 5/32                                                | 19/32                       | 15/32                                | 3/16                                                      |
| 2½                   | NH      |           | 7½                         | 2½                                              | 3 1/16                                          | 1                          | 3/4                                                 | 15/16                       | 1 1/16                               | 3/4                                                       |
| 3                    | NH      |           | 6                          | 3                                               | 3 5/8                                           | 1 1/8                      | 5/16                                                | 1 1/16                      | 3/4                                  | 3/4                                                       |
| 3½                   | NH      |           | 6                          | 3 1/2                                           | 4 1/4                                           | 1 1/8                      | 5/16                                                | 1 1/16                      | 3/4                                  | 3/4                                                       |
| 4                    | NH(SPL) |           | 6                          | 4                                               | 4 9/32                                          | 1 1/8                      | 5/16                                                | 1 1/16                      | 3/4                                  | 3/4                                                       |
| 4½                   | NH      |           | 4                          | 4                                               | 5                                               | 1 1/4                      | 7/16                                                | 1 3/16                      | 7/8                                  | 3/8                                                       |
| 5                    | NH      |           | 4                          | 4 1/2                                           | 5 3/4                                           | 1 1/4                      | 7/16                                                | 1 3/16                      | 7/8                                  | 3/8                                                       |
| 6                    | NH      |           | 4                          | 5                                               | 6 1/4                                           | 1 3/8                      | 7/16                                                | 1 5/16                      | 1                                    | 3/8                                                       |
|                      |         |           | 4                          | 6                                               | 7 1/2                                           | 1 3/8                      | 7/16                                                | 1 5/16                      | 1                                    | 3/8                                                       |

\* Data on the 4-6NH(SPL) thread are included since this thread is used extensively by the Navy Department.

TABLE X.6.—Tolerances and allowances for American National hose coupling and American National fire-hose coupling threads, NPSH and NH

| Nominal size of hose | Symbol  | Service                                                                                     | Threads per inch | Allowance  | Tolerance <sup>a</sup> on pitch diameter | Lead <sup>b</sup> deviation consuming one-half of pitch-diameter tolerance | Deviation in half angle consuming one-half of pitch-diameter tolerance |
|----------------------|---------|---------------------------------------------------------------------------------------------|------------------|------------|------------------------------------------|----------------------------------------------------------------------------|------------------------------------------------------------------------|
| 1                    | 2       | 3                                                                                           | 4                | 5          | 6                                        | 7                                                                          | 8                                                                      |
| <i>in.</i>           |         |                                                                                             |                  | <i>in.</i> | <i>in.</i>                               | <i>in.</i>                                                                 | <i>deg. min.</i>                                                       |
| 1/4, 3/8, 1/2        | NH      | Garden hose                                                                                 | 11 1/2           | 0.0100     | 0.0085                                   | 0.0025                                                                     | 1 52                                                                   |
| 3/4, 1               | NH      | Chemical engine and booster hose                                                            | 8                | .0120      | .0111                                    | .0032                                                                      | 1 42                                                                   |
| 1 1/2                | NH      | Fire hose                                                                                   | 9                | .0120      | .0111                                    | .0032                                                                      | 1 54                                                                   |
| 3/4                  | NPSH    | Steam, air, water, and all other hose connections to be made up with standard pipe threads. | 14               | .0075      | .0070                                    | .0020                                                                      | 1 52                                                                   |
| 1                    | NPSH    |                                                                                             | 14               | .0075      | .0070                                    | .0020                                                                      | 1 52                                                                   |
| 1 1/4                | NPSH    |                                                                                             | 11 1/2           | .0100      | .0085                                    | .0025                                                                      | 1 52                                                                   |
| 1 1/2                | NPSH    |                                                                                             | 11 1/2           | .0100      | .0085                                    | .0025                                                                      | 1 52                                                                   |
| 2                    | NPSH    |                                                                                             | 11 1/2           | .0100      | .0085                                    | .0025                                                                      | 1 52                                                                   |
| 2 1/2                | NH      |                                                                                             | 7 1/2            | .0150      | .0160                                    | .0046                                                                      | 2 17                                                                   |
| 3                    | NH      | Fire hose                                                                                   | 6                | .0150      | .0180                                    | .0052                                                                      | 2 4                                                                    |
| 3 1/2                | NH      |                                                                                             | 6                | .0200      | .0180                                    | .0052                                                                      | 2 4                                                                    |
| 4                    | NH(SPL) |                                                                                             | 6                | .0201      | .0180                                    | .0052                                                                      | 2 4                                                                    |
| 4 1/2                | NH      |                                                                                             | 4                | .0250      | .0250                                    | .0072                                                                      | 1 55                                                                   |
| 5                    | NH      |                                                                                             | 4                | .0250      | .0250                                    | .0072                                                                      | 1 55                                                                   |
| 6                    | NH      |                                                                                             | 4                | .0250      | .0250                                    | .0072                                                                      | 1 55                                                                   |

<sup>a</sup> The tolerances specified for pitch diameter include all deviations of pitch diameter, lead, and angle. The full tolerance cannot, therefore, be used on pitch diameter unless the lead and angle of the thread are perfect. Columns 7 and 8 give, for information, the deviations in lead (per length of thread engaged) and in angle, each of which can be compensated for by half the tolerance on the pitch diameter given in column 6. If lead and angle deviations both

exist to the amount tabulated, the pitch diameter of a nipple, for example, must be reduced by the full tolerance or it will not enter the "go" gage.

<sup>b</sup> Between any two threads not farther apart than the length of engagement.

<sup>c</sup> Data on the 4-6NH(SPL) thread are included since this thread is used extensively by the Navy Department.

TABLE X.7.—Limits of size of gages for American National hose-coupling threads, NPSH (all sizes), and for American National fire-hose coupling threads, NH (up to and including the 1½ in. size)

| Limits of size                                                                        | Service          |                                      |                          |                                                                                                  |            |            |            |            |            |            |
|---------------------------------------------------------------------------------------|------------------|--------------------------------------|--------------------------|--------------------------------------------------------------------------------------------------|------------|------------|------------|------------|------------|------------|
|                                                                                       | Garden hose, NH  | Chemical engine and booster hose, NH | Fire protection hose, NH | Steam, air, water, and all other hose connections to be made up with standard pipe threads, NPSH |            |            |            |            |            |            |
|                                                                                       | Size             |                                      |                          |                                                                                                  |            |            |            |            |            |            |
|                                                                                       | ½, ¾, 1          | ¾, 1                                 | 1½                       | ½                                                                                                | ¾          | 1          | 1¼         | 1½         | 2          |            |
|                                                                                       | Threads per inch |                                      |                          |                                                                                                  |            |            |            |            |            |            |
|                                                                                       | 11½              | 8                                    | 9                        | 14                                                                                               | 14         | 11½        | 11½        | 11½        | 11½        |            |
| Limits of size                                                                        |                  |                                      |                          |                                                                                                  |            |            |            |            |            |            |
| Nipple (external) thread                                                              |                  |                                      |                          |                                                                                                  |            |            |            |            |            |            |
| "Go" Thread Gages for Nipples                                                         |                  |                                      |                          |                                                                                                  |            |            |            |            |            |            |
| Major diameter of basic-form setting plug, and full portion of truncated setting plug | Max              | in. 1.0625                           | in. 1.3750               | in. 1.9900                                                                                       | in. 0.8248 | in. 1.0353 | in. 1.2951 | in. 1.6399 | in. 1.8788 | in. 2.3528 |
|                                                                                       | Min              | 1.0619                               | 1.3743                   | 1.9893                                                                                           | .8242      | 1.0347     | 1.2945     | 1.6393     | 1.8782     | 2.3522     |
| Major diameter of truncated portion of truncated setting plug                         | Max              | 1.0455                               | 1.3528                   | 1.9678                                                                                           | .8108      | 1.0213     | 1.2781     | 1.6229     | 1.8618     | 2.3358     |
|                                                                                       | Min              | 1.0449                               | 1.3521                   | 1.9671                                                                                           | .8102      | 1.0207     | 1.2775     | 1.6223     | 1.8612     | 2.3352     |
|                                                                                       | Max X            | 1.0090                               | 1.2938                   | 1.9178                                                                                           | .7784      | .9689      | 1.2386     | 1.5834     | 1.8223     | 2.2963     |
|                                                                                       | Min X            | 1.0057                               | 1.2934                   | 1.9175                                                                                           | .7781      | .9686      | 1.2383     | 1.5831     | 1.8220     | 2.2959     |
| Pitch diameter of setting plug or ring gage                                           | Max Y            | 1.0058                               | 1.2936                   | 1.9176                                                                                           | .7782      | .9687      | 1.2384     | 1.5832     | 1.8221     | 2.2961     |
|                                                                                       | Min Y            | 1.0054                               | 1.2931                   | 1.9171                                                                                           | .7778      | .9683      | 1.2380     | 1.5828     | 1.8217     | 2.2955     |
| Minor diameter of ring gage                                                           | Max              | .9585                                | 1.2246                   | 1.8577                                                                                           | .7395      | .9500      | 1.1921     | 1.5369     | 1.7758     | 2.2496     |
|                                                                                       | Min              | .9589                                | 1.2239                   | 1.8570                                                                                           | .7389      | .9494      | 1.1915     | 1.5363     | 1.7752     | 2.2492     |
| "Not Go" Thread Gages for Nipples                                                     |                  |                                      |                          |                                                                                                  |            |            |            |            |            |            |
| Major diameter of basic-form setting plug, and full portion of truncated setting plug | Min              | 1.0619                               | 1.3743                   | 1.9893                                                                                           | .8242      | 1.0347     | 1.2945     | 1.6393     | 1.8782     | 2.3522     |
|                                                                                       | Max              | 1.0625                               | 1.3750                   | 1.9900                                                                                           | .8248      | 1.0353     | 1.2951     | 1.6399     | 1.8788     | 2.3528     |
| Major diameter of truncated portion of truncated setting plug                         | Min              | 1.0346                               | 1.3361                   | 1.9541                                                                                           | .8017      | 1.0122     | 1.2672     | 1.6120     | 1.8509     | 2.3249     |
|                                                                                       | Max              | 1.0352                               | 1.3368                   | 1.9548                                                                                           | .8023      | 1.0128     | 1.2678     | 1.6126     | 1.8515     | 2.3255     |
| Pitch diameter of setting plug or ring gage                                           | Min              | .9975                                | 1.2827                   | 1.9067                                                                                           | .7714      | .9619      | 1.2301     | 1.5749     | 1.8138     | 2.2878     |
|                                                                                       | Max              | .9978                                | 1.2831                   | 1.9070                                                                                           | .7717      | .9622      | 1.2304     | 1.5752     | 1.8141     | 2.2882     |
| Minor diameter of ring gage                                                           | Min              | .9787                                | 1.2556                   | 1.8826                                                                                           | .7559      | .9664      | 1.2113     | 1.5561     | 1.7950     | 2.2600     |
|                                                                                       | Max              | .9793                                | 1.2563                   | 1.8833                                                                                           | .7565      | .9670      | 1.2119     | 1.5567     | 1.7956     | 2.2606     |
| Plain Gages for Nipples                                                               |                  |                                      |                          |                                                                                                  |            |            |            |            |            |            |
| "Go" gages for major diameter                                                         | Max              | 1.06250                              | 1.37500                  | 1.99000                                                                                          | .82480     | 1.03530    | 1.29510    | 1.63990    | 1.87890    | 2.35280    |
|                                                                                       | Min              | 1.06241                              | 1.37491                  | 1.98988                                                                                          | .82473     | 1.03521    | 1.29501    | 1.63978    | 1.87808    | 2.35268    |
| "Not go" gages for major diameter                                                     | Min              | 1.04550                              | 1.35280                  | 1.96780                                                                                          | .81080     | 1.02130    | 1.27810    | 1.62290    | 1.86180    | 2.33580    |
|                                                                                       | Max              | 1.04559                              | 1.35289                  | 1.96792                                                                                          | .81087     | 1.02139    | 1.27819    | 1.62302    | 1.86192    | 2.33592    |
| Coupling (internal) thread                                                            |                  |                                      |                          |                                                                                                  |            |            |            |            |            |            |
| "Go" Thread Gages for Couplings                                                       |                  |                                      |                          |                                                                                                  |            |            |            |            |            |            |
| Major diameter of plug gage                                                           | Min              | 1.0725                               | 1.3870                   | 2.0020                                                                                           | 0.8323     | 1.0428     | 1.3051     | 1.6499     | 1.8888     | 2.3628     |
|                                                                                       | Max              | 1.0731                               | 1.3877                   | 2.0027                                                                                           | .8329      | 1.0434     | 1.3057     | 1.6505     | 1.8894     | 2.3634     |
| Pitch diameter of plug gage                                                           | Min              | 1.0160                               | 1.3058                   | 1.9298                                                                                           | .7859      | .9664      | 1.2486     | 1.5934     | 1.8323     | 2.3063     |
|                                                                                       | Max              | 1.0163                               | 1.3062                   | 1.9301                                                                                           | .7862      | .9667      | 1.2489     | 1.5937     | 1.8326     | 2.3067     |
| "Not Go" Thread Gages for Couplings                                                   |                  |                                      |                          |                                                                                                  |            |            |            |            |            |            |
| Major diameter of plug gage                                                           | Max              | 1.0622                               | 1.3710                   | 1.9890                                                                                           | .8238      | 1.0343     | 1.2948     | 1.6396     | 1.8785     | 2.3525     |
|                                                                                       | Min              | 1.0616                               | 1.3703                   | 1.9883                                                                                           | .8232      | 1.0337     | 1.2942     | 1.6390     | 1.8779     | 2.3519     |
| Pitch diameter of plug gage                                                           | Max              | 1.0245                               | 1.3169                   | 1.9409                                                                                           | .7929      | 1.0034     | 1.2571     | 1.6019     | 1.8408     | 2.3148     |
|                                                                                       | Min              | 1.0242                               | 1.3165                   | 1.9406                                                                                           | .7926      | 1.0031     | 1.2568     | 1.6016     | 1.8405     | 2.3144     |
| Plain Gages for Couplings                                                             |                  |                                      |                          |                                                                                                  |            |            |            |            |            |            |
| "Go" gages for minor diameter                                                         | Min              | .95960                               | 1.22460                  | 1.85770                                                                                          | .78950     | .95000     | 1.19210    | 1.53690    | 1.77580    | 2.24980    |
|                                                                                       | Max              | .95959                               | 1.22459                  | 1.85782                                                                                          | .78957     | .95009     | 1.19219    | 1.53702    | 1.77592    | 2.24992    |
| "Not go" gages for minor diameter                                                     | Max              | .97650                               | 1.24680                  | 1.87990                                                                                          | .75350     | .96400     | 1.20910    | 1.55390    | 1.79280    | 2.26680    |
|                                                                                       | Min              | .97641                               | 1.24671                  | 1.87978                                                                                          | .75343     | .96391     | 1.20901    | 1.55378    | 1.79268    | 2.26668    |

**TABLE X.8.—Tolerances on gages for American National fire-hose coupling threads, NH (2½ in. size and larger)**

| Allowable variation in lead between any two threads not farther apart than length of engagement | Allowable variation in one half angle of thread | Tolerance on diameter of minimum thread gage | Tolerance on diameter of maximum thread gage |
|-------------------------------------------------------------------------------------------------|-------------------------------------------------|----------------------------------------------|----------------------------------------------|
| 1                                                                                               | 2                                               | 3                                            | 4                                            |
| in.                                                                                             | deg min                                         | in.                                          | in.                                          |
| ±0.0005                                                                                         | ±0 10                                           | -0.000<br>+0.001                             | +0.000<br>-0.001                             |

**TABLE X.9.—Limits of size of field inspection thread ring gages for American National fire-hose coupling external threads, NH nipples (2½ in. size and larger) \***

| Nominal size of hose | Threads per inch | "Go" or maximum gage |        |                |        | "Not go" or minimum gage |        |                |        |
|----------------------|------------------|----------------------|--------|----------------|--------|--------------------------|--------|----------------|--------|
|                      |                  | Pitch diameter       |        | Minor diameter |        | Pitch diameter           |        | Minor diameter |        |
|                      |                  | Max                  | Min    | Max            | Min    | Max                      | Min    | Max            | Min    |
| 1                    | 2                | 3                    | 4      | 5              | 6      | 7                        | 8      | 9              | 10     |
| in.                  |                  | in.                  | in.    | in.            | in.    | in.                      | in.    | in.            | in.    |
| 2.500                | 7½               | 2.9820               | 2.9810 | 2.9104         | 2.9094 | 2.9670                   | 2.9660 | 2.9114         | 2.9104 |
| 3.000                | 6                | 3.5156               | 3.5146 | 3.4223         | 3.4213 | 3.4986                   | 3.4976 | 3.4233         | 3.4223 |
| 3.500                | 6                | 4.1356               | 4.1346 | 4.0473         | 4.0463 | 4.1186                   | 4.1176 | 4.0483         | 4.0473 |
| 4.000                | 6                | 4.7990               | 4.7980 | 4.7117         | 4.7107 | 4.7829                   | 4.7819 | 4.7127         | 4.7117 |
| 4.000                | 4                | 4.8485               | 4.8475 | 4.7111         | 4.7101 | 4.8245                   | 4.8235 | 4.7121         | 4.7111 |
| 4.500                | 4                | 5.5985               | 5.5975 | 5.4611         | 5.4601 | 5.5745                   | 5.5735 | 5.4621         | 5.4611 |
| 5.000                | 4                | 6.0976               | 6.0966 | 5.9602         | 5.9592 | 6.0736                   | 6.0726 | 5.9612         | 5.9602 |
| 6.000                | 4                | 6.8626               | 6.8616 | 6.7252         | 6.7242 | 6.8386                   | 6.8376 | 6.7262         | 6.7252 |

\* The minor diameters of plug gages and the major diameters of ring gages are undercut beyond the nominal diameters to give clearance for grinding or lapping. The allowable variation in lead between any two threads not farther apart than the length of engagement is ±0.0005 in. The allowable variation in one-half angle of thread is ±10 min.

† Data on the 4—6 thread are included since this thread is used extensively by the Navy Department. It is to be designated: 4—6NH(SPL).

**TABLE X.10.—Limits of size of field inspection thread plug gages for American National fire-hose coupling internal threads, NH couplings (2½ in. size and larger) \***

| Nominal size of hose | Threads per inch | "Go" or minimum gage |        |                |        | "Not go" or maximum gage |        |                |        |
|----------------------|------------------|----------------------|--------|----------------|--------|--------------------------|--------|----------------|--------|
|                      |                  | Major diameter       |        | Pitch diameter |        | Major diameter           |        | Pitch diameter |        |
|                      |                  | Max                  | Min    | Max            | Min    | Max                      | Min    | Max            | Min    |
| 1                    | 2                | 3                    | 4      | 5              | 6      | 7                        | 8      | 9              | 10     |
| in.                  |                  | in.                  | in.    | in.            | in.    | in.                      | in.    | in.            | in.    |
| 2.500                | 7½               | 3.0846               | 3.0836 | 2.9980         | 2.9970 | 3.0636                   | 3.0626 | 3.0130         | 3.0120 |
| 3.000                | 6                | 3.6399               | 3.6389 | 3.5316         | 3.5306 | 3.6389                   | 3.6379 | 3.5486         | 3.5476 |
| 3.500                | 6                | 4.2649               | 4.2639 | 4.1566         | 4.1556 | 4.2639                   | 4.2629 | 4.1736         | 4.1726 |
| 4.000                | 6                | 4.9293               | 4.9283 | 4.8210         | 4.8200 | 4.9283                   | 4.9273 | 4.8380         | 4.8370 |
| 4.000                | 4                | 5.0359               | 5.0359 | 4.8745         | 4.8735 | 5.0359                   | 5.0349 | 4.8965         | 4.8955 |
| 4.500                | 4                | 5.7869               | 5.7859 | 5.6245         | 5.6235 | 5.7859                   | 5.7849 | 5.6485         | 5.6475 |
| 5.000                | 4                | 6.2860               | 6.2850 | 6.1236         | 6.1226 | 6.2850                   | 6.2840 | 6.1476         | 6.1466 |
| 6.000                | 4                | 7.0510               | 7.0500 | 6.8886         | 6.8876 | 7.0500                   | 7.0490 | 6.9126         | 6.9116 |

\* The minor diameters of plug gages and the major diameters of ring gages are undercut beyond the nominal diameters to give a clearance for grinding or lapping. The allowable variation in lead between any two threads not farther apart than the length of engagement is ±0.0005 in. The allowable variation in one-half angle of thread is ±10 min.

† Data on the 4—6 thread are included since this thread is used extensively by the Navy Department. It is to be designated: 4—6NH(SPL).

## SECTION XI. HOSE CONNECTIONS FOR WELDING AND CUTTING EQUIPMENT

Specifications covering hose connections for welding and cutting equipment were formulated and adopted in 1925 by the International Acetylene Association, the Gas Products Association, and various manufacturers. Essentially the same specifications were adopted by the National Screw Thread Commission in 1926.

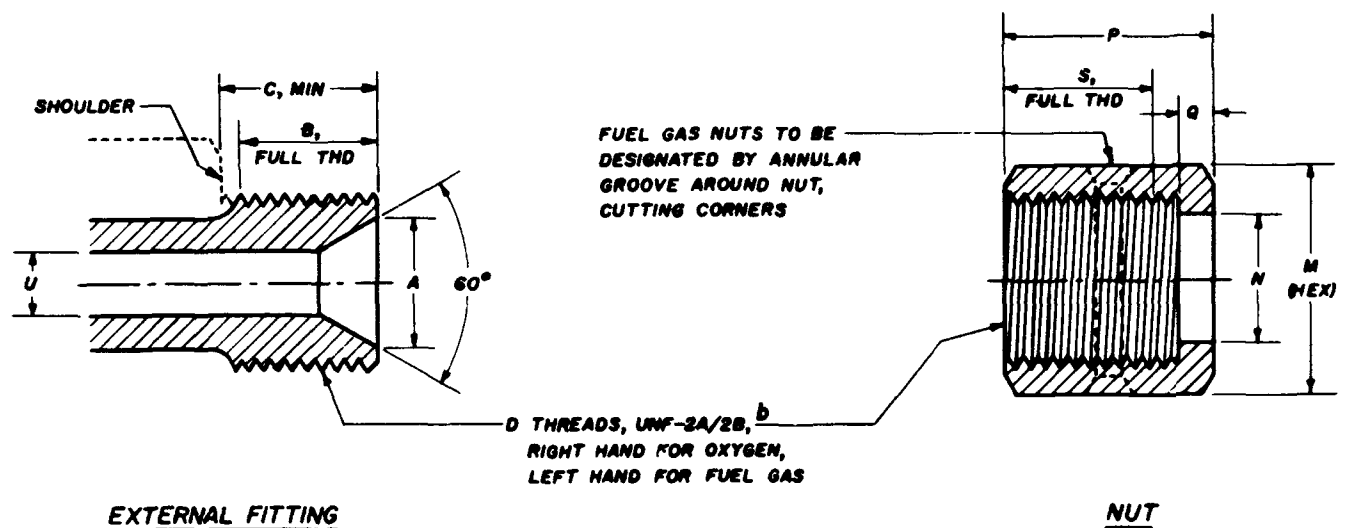
Revised specifications for these connections were adopted by the International Acetylene Association, March 9, 1939. These revised specifications were amended several times; the most recent amendment having been on April 1, 1957. These revised specifications, as amended, were adopted by the Interdepartmental Screw Thread Committee and are presented below.

Dimensions essential to the interchangeability of parts have been standardized. Other dimensions and details of design are optional, so that manufacturers may use their own judgment and follow their usual practice as much as possible.

The hose connection consists of an external fitting, nut, and shank. Dimensions for the type I hose connection external fittings and nuts for oxygen and fuel gas are shown in table XI.1. Dimensions for the type II hose connection external fittings and nuts for water and gases other than oxygen and fuel gas are shown in table XI.2.

The shanks are interchangeable for types I and II for any given class. Dimensions for the hose connection shanks are shown in table XI.3.

TABLE XI.1—Dimensions for American National standard hose connection external fittings and nuts for oxygen and fuel gas<sup>a</sup> used with welding and cutting equipment, type I



| Thread size, D     | Industry designation, class | For use with hose of inside diameter of—                                        | External fitting          |               |                          |                       |                | Nut                           |                     |               |                    |                   |                         |
|--------------------|-----------------------------|---------------------------------------------------------------------------------|---------------------------|---------------|--------------------------|-----------------------|----------------|-------------------------------|---------------------|---------------|--------------------|-------------------|-------------------------|
|                    |                             |                                                                                 | Large diameter of seat, A |               | Length of full thread, B | Length to shoulder, C | Bore, U        | Width across hexagon flats, M | Diameter of hole, N |               | Over-all length, P | Length of hole, Q | Depth of full thread, S |
|                    |                             |                                                                                 | Max                       | Min           |                          | Min                   |                |                               | Max                 | Min           |                    |                   |                         |
| 1                  | 2                           | 3                                                                               | 4                         | 5             | 6                        | 7                     | 8              | 9                             | 10                  | 11            | 12                 | 13                | 14                      |
| $\frac{3}{8}$ —24  | A                           | $\frac{1}{8}$ , $\frac{3}{16}$                                                  | $\frac{1}{8}$             | $\frac{1}{8}$ | $\frac{1}{8}$            | $\frac{1}{8}$         | $\frac{1}{8}$  | $\frac{1}{8}$                 | $\frac{1}{8}$       | $\frac{1}{8}$ | $\frac{1}{8}$      | $\frac{1}{8}$     | $\frac{1}{8}$           |
| $\frac{1}{2}$ —18  | B                           | $\frac{1}{4}$ , $\frac{3}{16}$ , $\frac{1}{2}$ , $\frac{5}{16}$ , $\frac{3}{8}$ | .438                      | .428          | $\frac{5}{16}$           | $\frac{13}{32}$       | $\frac{1}{4}$  | $\frac{11}{16}$               | .4425               | .4375         | $\frac{5}{8}$      | $\frac{3}{8}$     | $\frac{5}{16}$          |
| $\frac{3}{4}$ —14  | C                           | $\frac{1}{2}$ , $\frac{5}{16}$ , $\frac{3}{8}$ , $\frac{1}{2}$                  | .630                      | .620          | $\frac{11}{16}$          | $\frac{23}{32}$       | $\frac{3}{8}$  | $\frac{13}{16}$               | .5997               | .5907         | 1                  | $\frac{3}{4}$     | $\frac{11}{16}$         |
| $1\frac{1}{4}$ —12 | D                           | $\frac{3}{4}$ , $\frac{1}{2}$ , $\frac{3}{4}$                                   | .962                      | .946          | $\frac{7}{8}$            | $\frac{31}{32}$       | $\frac{9}{16}$ | $\frac{11}{16}$               | .9122               | .9042         | $1\frac{1}{4}$     | $\frac{7}{8}$     | $\frac{15}{16}$         |

<sup>a</sup> The hose connection consists of the external fitting and nut shown in this table and the shank shown in table XI.3.

<sup>b</sup> See section III for dimensions of threads and method of designating threads, and section VI for gaging of threads.

## 1. STANDARD DIMENSIONS <sup>11</sup>

Dimensions for the following have been standardized and should be met.

1. Size, type, and class of thread.
2. Angle and large diameter of internal seat.
3. Radius and distance of radius center of external seat from shank shoulder.
4. Diameter of shank shoulder.
5. Diameter of drilling through external fitting and shank.
6. Diameter of hole in nut.
7. Large diameter of hose shank.

<sup>11</sup> Designs of gages for controlling dimensions other than thread dimensions of these connections were published in NBS Miscellaneous Publications M89 and M141, and Handbook H25.

The gaging of the threads is covered in section VI.

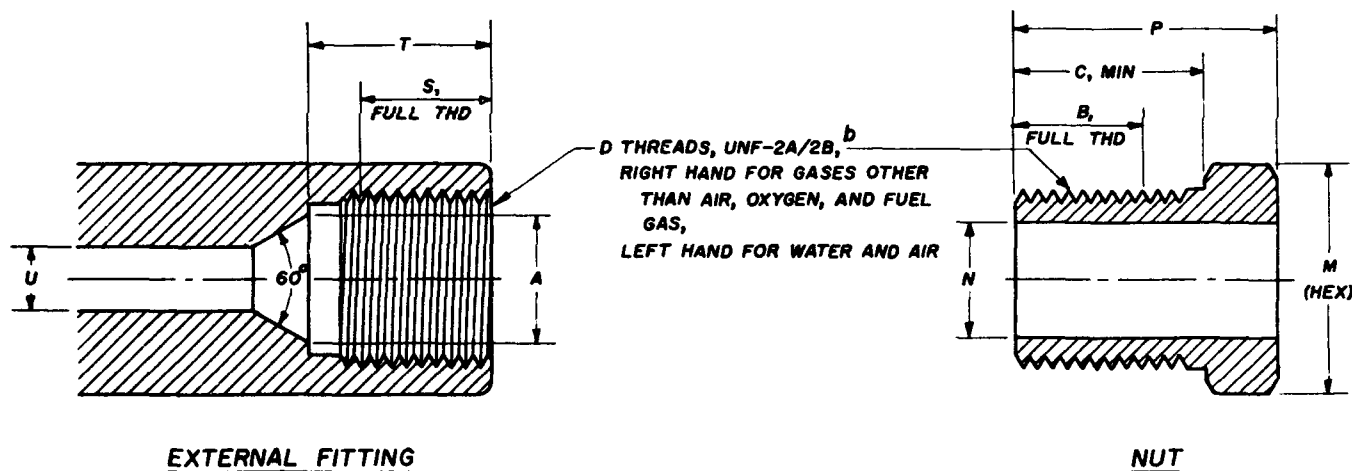
8. Fuel gas nuts to be designated by an annular groove around the nut, cutting corners.

## 2. OPTIONAL FEATURES

The following features are optional.

1. Material, except that its strength shall be equal to or greater than that of free-turning high brass.
2. Form of end of shank except seating section as dimensioned.
3. Length of hose shank.
4. Type and number of serrations on hose shank.
5. A second shoulder, equal to the larger diameter of the largest shank to extend through the hole in the nut for appearance, may be used or omitted for smaller diameter shanks.
6. Length and location of hexagon wrench section on nut.

TABLE XI.2—Dimensions for American National standard hose connection external fittings and nuts for water and gases <sup>a</sup> other than oxygen and fuel gas used with oxygen-fuel gas welding and cutting equipment, type II

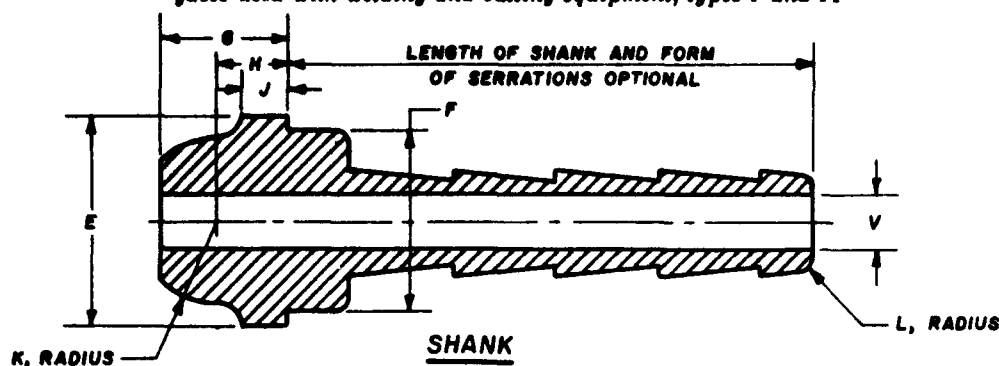


| Thread size, <i>D</i> | Industry designation, class | For use with hose of inside diameter of—                      | External fitting                 |       |                                |                 |                | Nut                             |                                    |                                      |                            |       |                           |
|-----------------------|-----------------------------|---------------------------------------------------------------|----------------------------------|-------|--------------------------------|-----------------|----------------|---------------------------------|------------------------------------|--------------------------------------|----------------------------|-------|---------------------------|
|                       |                             |                                                               | Large diameter of seat, <i>A</i> |       | Depth of full thread, <i>S</i> | Depth, <i>T</i> | Bore, <i>U</i> | Length of full thread, <i>B</i> | Length to shoulder, <i>C</i> (Min) | Width across hexagon flats, <i>M</i> | Diameter of hole, <i>N</i> |       | Over-all length, <i>P</i> |
|                       |                             |                                                               | Max                              | Min   |                                |                 |                |                                 |                                    |                                      | Max                        | Min   |                           |
| 1                     | 2                           | 3                                                             | 4                                | 5     | 6                              | 7               | 8              | 9                               | 10                                 | 11                                   | 12                         | 13    | 14                        |
| $\frac{3}{8}$ —24     | A                           | $\frac{1}{8}$ , $\frac{3}{16}$ in.                            | 0.255                            | 0.245 | $\frac{9}{32}$                 | $\frac{3}{8}$   | $\frac{3}{32}$ | $\frac{9}{32}$                  | $\frac{3}{8}$                      | $\frac{1}{16}$                       | 0.262                      | 0.257 | $\frac{1}{2}$             |
| $\frac{1}{2}$ —18     | B                           | $\frac{3}{8}$ , $\frac{1}{2}$ , $\frac{5}{8}$ , $\frac{3}{4}$ | .438                             | .428  | $\frac{3}{8}$                  | $\frac{1}{2}$   | $\frac{1}{4}$  | $\frac{3}{8}$                   | $\frac{1}{16}$                     | $\frac{1}{16}$                       | .4425                      | .4375 | $\frac{3}{8}$             |
| $\frac{3}{4}$ —14     | C                           | $\frac{1}{2}$ , $\frac{5}{8}$ , $\frac{3}{4}$ , $\frac{1}{2}$ | .630                             | .620  | $\frac{1}{16}$                 | $\frac{7}{16}$  | $\frac{3}{16}$ | $\frac{1}{16}$                  | $\frac{1}{16}$                     | $\frac{1}{16}$                       | .5997                      | .5907 | $\frac{1}{2}$             |
| $1\frac{1}{4}$ —12    | D                           | $\frac{3}{4}$ , $\frac{1}{2}$ , $\frac{3}{4}$                 | .962                             | .946  | $\frac{1}{16}$                 | $1\frac{1}{8}$  | $\frac{1}{16}$ | $\frac{1}{16}$                  | $\frac{1}{16}$                     | $\frac{1}{16}$                       | .9122                      | .9042 | $1\frac{1}{2}$            |

<sup>a</sup> The hose connection consists of the external fitting and nut shown in this table and the shank shown in table XI.3.

<sup>a</sup> See section III for dimensions of threads and method of designating threads, and section VI for gaging of threads.

**TABLE XI.3—Dimensions for American National standard hose connection shanks for water, oxygen, fuel gas, and other gases used with welding and cutting equipment, types I and II**



| Thread<br>size, <i>D</i> | Industry<br>designation,<br>class | For use with hose of<br>inside diameter of— | Diam-<br>eter of<br>hole, <i>V</i><br>(min) | Diameter of<br>shoulder, <i>E</i> |       | Diameter of<br>shank, <i>F</i> |       | Length<br>to<br>shoulder,<br><i>G</i> | Radius distance,<br><i>H</i> |       | Length<br>of<br>shoulder,<br><i>J</i> | Radius,<br><i>K</i> | Radius,<br><i>L</i> (min) |                |
|--------------------------|-----------------------------------|---------------------------------------------|---------------------------------------------|-----------------------------------|-------|--------------------------------|-------|---------------------------------------|------------------------------|-------|---------------------------------------|---------------------|---------------------------|----------------|
|                          |                                   |                                             |                                             | Max                               | Min   | Max                            | Min   |                                       | Max                          | Min   |                                       |                     |                           |                |
| 1                        | 2                                 | 3                                           | 4                                           | 5                                 | 6     | 7                              | 8     | 9                                     | 10                           | 11    | 12                                    | 13                  | 14                        |                |
| $\frac{3}{8}$ —24        | A                                 | in.                                         | $\frac{1}{8}$                               | $\frac{1}{8}$                     | 0.328 | 0.324                          | 0.248 | 0.243                                 | $\frac{1}{4}$                | 0.187 | 0.177                                 | $\frac{1}{4}$       | 0.099                     | $\frac{1}{4}$  |
| $\frac{1}{2}$ —18        | B                                 |                                             | $\frac{3}{16}$                              | $\frac{3}{16}$                    | .500  | .496                           | .430  | .425                                  | $\frac{3}{16}$               | .180  | .170                                  | $\frac{3}{16}$      | .196                      | $\frac{3}{16}$ |
| $\frac{3}{8}$ —18        |                                   |                                             | $\frac{1}{4}$                               | $\frac{1}{4}$                     |       |                                |       |                                       |                              |       |                                       |                     |                           |                |
| $\frac{1}{2}$ —18        |                                   |                                             | $\frac{5}{16}$                              | $\frac{5}{16}$                    |       |                                |       |                                       |                              |       |                                       |                     |                           |                |
|                          |                                   |                                             | $\frac{3}{8}$                               | $\frac{3}{8}$                     |       |                                |       |                                       |                              |       |                                       |                     |                           |                |
|                          |                                   |                                             | $\frac{1}{2}$                               | $\frac{1}{2}$                     |       |                                |       |                                       |                              |       |                                       |                     |                           |                |
| $\frac{3}{4}$ —14        | C                                 |                                             | $\frac{3}{16}$                              | $\frac{3}{16}$                    | .754  | .746                           | .578  | .568                                  | $\frac{3}{16}$               | .255  | .245                                  | $\frac{3}{16}$      | .280                      | $\frac{3}{16}$ |
|                          | D                                 |                                             | $\frac{1}{2}$                               | $\frac{1}{2}$                     | 1.140 | 1.132                          | .875  | .865                                  | $\frac{1}{2}$                | .335  | .319                                  | $\frac{3}{16}$      | .438                      | $\frac{3}{16}$ |
| $1\frac{1}{4}$ —12       |                                   |                                             | $\frac{3}{4}$                               | $\frac{3}{4}$                     |       |                                |       |                                       |                              |       |                                       |                     |                           |                |
|                          |                                   |                                             | $\frac{1}{2}$                               | $\frac{1}{2}$                     |       |                                |       |                                       |                              |       |                                       |                     |                           |                |
|                          |                                   | $\frac{3}{4}$                               | $\frac{3}{4}$                               |                                   |       |                                |       |                                       |                              |       |                                       |                     |                           |                |
|                          |                                   | $\frac{1}{2}$                               | $\frac{1}{2}$                               |                                   |       |                                |       |                                       |                              |       |                                       |                     |                           |                |

\* The hose connection consists of the shank shown in this table and the external fitting and nut shown in tables XI.1 or XI.2, depending on the application.

\* Shown for cross-reference purposes as regards the external fittings and nuts shown in tables XI.1 and XI.2.

\* The  $\frac{1}{2}$ —18 thread size is for the external fitting and nut shown in table XI.1; the  $\frac{3}{4}$ —18 thread size is for the external fitting and nut shown in table XI.2.

## APPENDIX 7. SUPPLEMENTARY PIPE-THREAD INFORMATION

The information contained herein supplements sections VII and VIII.

### 1. DEFINITIONS AND LETTER SYMBOLS PERTAINING TO PIPE THREADS

1. **DEFINITIONS.**—Terms relating only to taper pipe threads are defined as follows:

1. **Pitch cone.**—The pitch cone is a cone, the surface of which would pass through the thread profiles at such points as to make the width of the groove equal to one half of the basic pitch. On a perfect thread this occurs at the point where the widths of the thread and groove are equal.

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

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

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

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

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

7. **Bottom of chamfer.**—On a chamfered internal taper thread the bottom of the chamfer is defined as the intersection of the chamfer cone and the pitch cone of the thread.

2. **LETTER SYMBOLS.**—Standard letter symbols used to designate the dimensions of taper pipe threads are given in table 7.1. The applications of the symbols are shown in figure 7.1.

### 2. SUGGESTED TWIST DRILL DIAMETERS FOR DRILLED HOLE SIZES FOR PIPE THREADS OF SECTION VII

The drill diameters given in table 7.2 for the drilled holes for taper and straight internal pipe threads are the diameters of the standard and stock drills which are the closest to the minimum minor diameters shown in table VII.2, column 22.

They represent the diameters of the holes which would be cut with a twist drill correctly ground when drilling a material without tearing or flow of metal. This is approximately the condition that exists when a correctly sharpened twist drill is cutting a hole in a homogeneous block of cast iron.

When flat drills are used, the width of the cutting edge may have to be adjusted to produce a hole of the required diameter.

When nonferrous metals and other similar materials are to be drilled and tapped, it may be found necessary to use a drill of slightly larger or smaller diameter to produce a

TABLE 7.1.—Pipe thread symbols (see fig. 7.1)

| Symbols                   | Dimensions                                                                                                                         | Remarks                                                                                                                                                                                                                                                                                                               |
|---------------------------|------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| $D$ .....                 | Outside diameter of pipe.....                                                                                                      | (Subscript 4 is used for dimensions in plane of vanish point when these differ from $D$ , $d$ , or $t$ , respectively.)<br>(Subscript $x$ denotes plane containing the diameter. For axial positions of planes see foot of this table. Subscripts $s$ or $a$ designating screw or nut may also be used if necessary.) |
| $d$ .....                 | Inside diameter of pipe.....                                                                                                       |                                                                                                                                                                                                                                                                                                                       |
| $t$ .....                 | Wall thickness of pipe.....                                                                                                        |                                                                                                                                                                                                                                                                                                                       |
| $D_s$ .....               | Major diameter.....                                                                                                                | For axial position of plane containing basic diameter, see foot of this table.                                                                                                                                                                                                                                        |
| $E_s$ .....               | Pitch diameter.....                                                                                                                |                                                                                                                                                                                                                                                                                                                       |
| $K_s$ .....               | Minor diameter.....                                                                                                                |                                                                                                                                                                                                                                                                                                                       |
| $L_s$ .....               | Length of thread from plane of pipe end to plane containing basic diameter $D_s$ , $E_s$ , or $K_s$ .....                          |                                                                                                                                                                                                                                                                                                                       |
| $V$ .....                 | Length of washout (vanish cone) threads.....                                                                                       |                                                                                                                                                                                                                                                                                                                       |
| $\beta$ (beta).....       | Half apex angle of pitch cone of taper thread.....                                                                                 |                                                                                                                                                                                                                                                                                                                       |
| $\gamma$ (gamma).....     | Angle of chamfer at end of pipe measured from a plane normal to the axis.....                                                      |                                                                                                                                                                                                                                                                                                                       |
| $A$ .....                 | Handtight standoff of face of coupling from plane containing vanish point on pipe.....                                             |                                                                                                                                                                                                                                                                                                                       |
| $M$ .....                 | Length from plane of handtight engagement to the face of coupling on internally threaded member.....                               |                                                                                                                                                                                                                                                                                                                       |
| $S$ .....                 | Distance of gaging step of plug gage from face of ring gage for handtight engagement.....                                          |                                                                                                                                                                                                                                                                                                                       |
| $L_a$ .....               | Length from center line of coupling, face of flange, or bottom of internal thread chamber to face of fitting.....                  |                                                                                                                                                                                                                                                                                                                       |
| $b$ .....                 | Width of bearing face on coupling.....                                                                                             |                                                                                                                                                                                                                                                                                                                       |
| $\tau$ (tau).....         | Angle of chamfer at bottom of recess or counterbore measured from the axis.....                                                    |                                                                                                                                                                                                                                                                                                                       |
| $\epsilon$ (epsilon)..... | Half apex angle of vanish cone.....                                                                                                |                                                                                                                                                                                                                                                                                                                       |
| $J$ .....                 | Length from center line of coupling, face of flange, or bottom of internal thread chamber to end of pipe, wrenched engagement..... |                                                                                                                                                                                                                                                                                                                       |

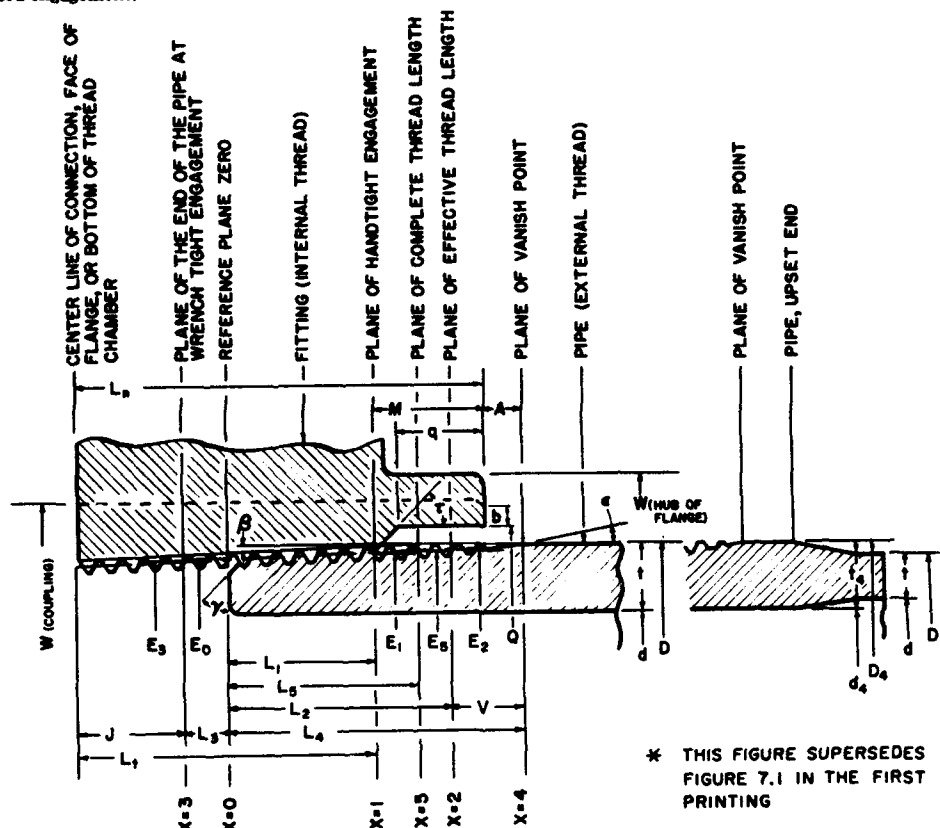
TABLE 7.1.—Pipe thread symbols—Continued

| Symbols     | Dimensions                                                                                                                           | Remarks |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------|---------|
| $L_1$ ..... | (1) Length of straight full thread.<br>(2) Length from plane of handtight engagement to small end of full internal taper thread..... |         |
| $Q$ .....   | Diameter of recess or counterbore in fitting.....                                                                                    |         |
| $q$ .....   | Depth of recess or counterbore in fitting.....                                                                                       |         |
| $W$ .....   | Outside diameter of coupling or hub of fitting.....                                                                                  |         |

DEFINITION OF PLANES DENOTED BY SUBSCRIPT  $x$ 

|             |                                                                                                                                                                                                                                    |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| $x=0$ ..... | Plane of pipe end.....                                                                                                                                                                                                             |
| $x=1$ ..... | Plane of handtight engagement or plane at mouth of coupling (excluding recess, if present). On British pipe threads this is designated the "gauge plane," and the major diameter in this plane is designated the "gauge diameter." |
| $x=2$ ..... | Plane at which washout threads on pipe commence.                                                                                                                                                                                   |
| $x=3$ ..... | Plane in coupling reached by end of pipe in wrenched condition. ( $L_s$ is measured from plane containing pipe end in position of handtight engagement.)                                                                           |
| $x=4$ ..... | Plane containing vanish point of thread on pipe.                                                                                                                                                                                   |
| $x=5$ ..... | Plane at which major diameter cone of thread intersects outside diameter of pipe.                                                                                                                                                  |

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



\* THIS FIGURE SUPERSEDES FIGURE 7.1 IN THE FIRST PRINTING

FIGURE 7.1.—Pipe thread symbols.

**TABLE 7.2.—Suggested twist drill diameters for drilled hole sizes for pipe threads**

| Nominal<br>pipe size | Taper thread       |         |                          |         | Straight pipe<br>thread |         |
|----------------------|--------------------|---------|--------------------------|---------|-------------------------|---------|
|                      | With use of reamer |         | Without use of<br>reamer |         |                         |         |
| 1                    | 2                  |         | 3                        |         | 4                       |         |
| in.                  | in.                | in.     | in.                      | in.     | in.                     | in.     |
| 1/8                  |                    | • 0.240 |                          | • 0.246 | 3/8                     | • 0.250 |
| 1/4                  | 2 3/64             | • 328   |                          | • 332   | 1 1/32                  | • 344   |
| 3/8                  | 2 3/64             | • 422   | 7/16                     | • 438   | 7/16                    | • 438   |
| 1/2                  | 9/16               | • 562   | 9/16                     | • 562   | 2 7/64                  | • 578   |
| 5/8                  | 1 1/16             | • 688   | 4 5/64                   | • 703   | 2 3/32                  | • 719   |
| 3/4                  | 2 3/64             | • 801   | 2 3/32                   | • 806   | 2 5/64                  | • 922   |
| 1                    | 1 1/8              | • 1.125 | 1 3/4                    | • 1.141 | 1 1/2                   | • 1.156 |
| 1 1/4                | 1 13/32            | 1.460   | 1 31/64                  | 1.484   | 1 5/8                   | 1.500   |
| 1 1/2                | 1 23/32            | 1.719   | 1 47/64                  | 1.734   | 1 3/4                   | 1.750   |
| 2                    | 2 9/16             | 2.188   | 2 13/64                  | 2.203   | 2 5/32                  | 2.219   |
| 2 1/2                | 2 19/32            | 2.594   | 2 3/4                    | 2.625   | 2 21/32                 | 2.656   |

• American Standard twist drill sizes.

hole of a size that will make it possible for the tap to cut an acceptable pipe thread with the required thread height.

It should be understood that this table of twist drill diameters is intended to help only the occasional user of drills in the application of this standard. When internal pipe threads are produced in larger quantities in a particular type of material and with specially designed machinery it may be found to be more advantageous to use a drill size not given in the table, even one having a nonstandard diameter.

### 3. SUGGESTED TWIST DRILL DIAMETERS FOR DRILLED HOLE SIZES FOR DRYSEAL PIPE THREADS OF SECTION VIII

The drill diameters given in table 7.3 are for taper and straight internal pipe threads and will usually permit the tapping of acceptable threads in free-machining brass or steel provided the drill is correctly sharpened. When

hard metals or other similar materials are to be drilled and tapped, it may be necessary to use a drill of slightly smaller diameter whereas soft materials may require a larger size.

**TABLE 7.3.—Suggested twist drill diameters for drilled hole sizes for Dryseal pipe threads**

| Nominal<br>pipe size | Taper thread       |                 |                          |                 | Straight<br>thread |                 |
|----------------------|--------------------|-----------------|--------------------------|-----------------|--------------------|-----------------|
|                      | With use of reamer |                 | Without use of<br>reamer |                 |                    |                 |
| 1                    | 2                  |                 | 3                        |                 | 4                  |                 |
| <i>in.</i>           | <i>in.</i>         | <i>in.</i>      | <i>in.</i>               | <i>in.</i>      | <i>in.</i>         | <i>in.</i>      |
| $\frac{1}{4}$        | $\frac{1}{4}$      | $\bullet 0.234$ | $\frac{1}{4}$            | $\bullet 0.246$ | $\frac{1}{4}$      | $\bullet 0.250$ |
| $\frac{1}{2}$        | $\frac{1}{2}$      | $\bullet 328$   | $\frac{1}{2}$            | $\bullet 339$   | $\frac{1}{2}$      | $\bullet 344$   |
| $\frac{3}{4}$        | $\frac{3}{4}$      | $\bullet 422$   | $\frac{3}{4}$            | $\bullet 438$   | $\frac{3}{4}$      | $\bullet 444$   |
| $1$                  | $1$                | $\bullet 562$   | $1$                      | $\bullet 578$   | $1$                | $\bullet 578$   |
| $1\frac{1}{2}$       | $1\frac{1}{2}$     | $\bullet 688$   | $1\frac{1}{2}$           | $\bullet 703$   | $1\frac{1}{2}$     | $\bullet 719$   |
| $2$                  | $2$                | $\bullet 801$   | $2$                      | $\bullet 822$   | $2$                | $\bullet 822$   |
| $1$                  | $1\frac{1}{4}$     | $\bullet 1.125$ | $1\frac{1}{4}$           | $\bullet 1.156$ | $1\frac{1}{4}$     | $\bullet 1.156$ |
| $1\frac{1}{4}$       | $1\frac{1}{2}$     | $1.460$         | $1\frac{1}{2}$           | $1.500$         |                    |                 |
| $1\frac{1}{2}$       | $1\frac{3}{4}$     | $1.703$         | $1\frac{3}{4}$           | $1.734$         |                    |                 |
| $2$                  | $2\frac{1}{4}$     | $2.188$         | $2\frac{1}{4}$           | $2.219$         |                    |                 |
| $2\frac{1}{4}$       | $2\frac{3}{4}$     | $2.594$         | $2\frac{3}{4}$           | $2.641$         |                    |                 |
| $3$                  | $3\frac{1}{2}$     | $3.219$         | $3\frac{1}{2}$           | $3.266$         |                    |                 |

• American Standard twist drill sizes.

Taper pipe threads of improved quality are obtained when the holes are taper reamed after drilling and before tapping. Standard taper pipe reamers are used and, as in drilling, the actual size of the hole depends upon the material and is best determined by trial.

### 4. THREADING OF PIPE FOR AMERICAN STANDARD THREADED STEEL FLANGES

The length of the effective external taper thread of the American Standard pipe thread provides a sufficient number of threads on the pipe to insure a satisfactory joint with the ordinary weight of fitting or flange. The

**TABLE 7.4.—Projection of threaded end through ring gage, standard threaded steel flanges**

| Nominal pipe size | 150, 300 lb.    | 400 lb.         | 600 lb.         |        | 900 lb.         |        | 1,500 lb.       |        | 2,500 lb.       |        |
|-------------------|-----------------|-----------------|-----------------|--------|-----------------|--------|-----------------|--------|-----------------|--------|
|                   | Number of turns | Number of turns | Number of turns | Inches | Number of turns | Inches | Number of turns | Inches | Number of turns | Inches |
| 1                 | 2               | 3               | 4               | 5      | 6               | 7      | 8               | 9      | 10              | 11     |
| 1/4               | (*)             |                 | (*)             | (*)    |                 |        | 3 1/2           | 0.250  | 7               | 0.500  |
| 3/4               | (*)             |                 | (*)             | (*)    |                 |        | 5               | .357   | 7               | .500   |
| 1                 | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 1 1/4             | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 1 1/2             | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 2                 | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 2 1/2             | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 3                 | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 3 1/2             | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 4                 | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 5                 | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 6                 | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 8                 | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 10                | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 12                | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 14 OD             | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 16 OD             | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 18 OD             | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 20 OD             | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 24 OD             | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 30 OD             | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 36 OD             | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 42 OD             | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 48 OD             | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 54 OD             | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 60 OD             | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 66 OD             | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 72 OD             | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 78 OD             | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 84 OD             | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 90 OD             | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 96 OD             | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 102 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 108 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 114 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 120 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 126 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 132 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 138 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 144 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 150 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 156 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 162 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 168 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 174 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 180 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 186 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 192 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 198 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 204 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 210 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 216 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 222 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 228 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 234 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 240 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 246 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 252 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 258 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 264 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 270 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 276 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 282 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 288 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 294 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 300 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 306 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 312 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 318 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 324 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 330 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 336 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 342 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 348 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 354 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 360 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 366 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 372 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 378 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 384 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 390 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 396 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 402 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 408 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 414 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 420 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 426 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 432 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 438 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 444 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 450 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 456 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 462 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 468 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 474 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 480 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 486 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 492 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 498 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 504 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 510 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 516 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 522 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 528 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 534 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 540 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 546 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 552 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 558 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 564 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 570 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 576 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 582 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 588 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 594 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |
| 600 OD            | (*)             |                 | (*)             | (*)    |                 |        | 5               | .435   | 7 1/2           | .650   |

American Standard Steel Flanges for high pressure-temperature service (ASA B16.5) calls for thread lengths in the flanges in proportion to the thickness of the flange. This means that the thread lengths in the flanges intended for higher pressures in a given size are longer than the thread lengths in the flanges intended for the lower pressures.

Table 7.4 provides for a length of effective thread on pipe for sizes and weights of flanges where the regular American Standard length of effective thread is too short to bring the end of the pipe reasonably close to the face of the flange when both parts are assembled by power. As the threads in all flanges as well as on the pipe are gaged with a tolerance of one thread large and one thread small there will naturally be some difference in distance between the end of the pipe and face of the flange in the various assemblies for the different sizes and weights of flanges.

In table 7.4 the additional number of threads are added to the small end of the standard pipe thread. The pitch diameter at the end of the external thread is, therefore, smaller than that of the regular standard pipe. In other words, the small end of the ring gage will pass over the end of the pipe the number of turns or the length in inches equal to the values given in table 7.4.

## 5. INTERNAL STRAIGHT PIPE THREADS IN FINISHED DRUMS AND EXTERNAL THREADS ON PLUGS

The screw threads which have been used for some years to hold the bung plugs in steel barrels or drums are another application of straight pipe threads.<sup>12</sup>

The flanges of the bung and vent are tapped respectively with 2 in. and 3/4 in. American Standard form straight pipe thread having dimensions in accordance with table 7.5.

TABLE 7.5.—Drum plug and flange thread limits of size and tolerances

| Item        | Size | Threads per inch | Major diameter |           |         |
|-------------|------|------------------|----------------|-----------|---------|
|             |      |                  | Maximum        | Tolerance | Minimum |
|             | in.  |                  | in.            | in.       | in.     |
| Flange..... | 3/4  | 14               |                |           | 1.0324  |
| Plug.....   | 3/4  | 14               | 1.0274         | 0.0200    | 1.0074  |
| Flange..... | 2    | 11 1/2           |                |           | 2.3495  |
| Plug.....   | 2    | 11 1/2           | 2.3395         | .0200     | 2.3195  |

| Item        | Pitch diameter |           |         | Minor diameter |           |         |
|-------------|----------------|-----------|---------|----------------|-----------|---------|
|             | Maximum        | Tolerance | Minimum | Maximum        | Tolerance | Minimum |
|             | in.            | in.       | in.     | in.            | in.       | in.     |
| Flange..... | 1.0045         | .0185     | .9860   | 0.9648         | 0.0200    | 0.9448  |
| Plug.....   | .9810          | .0180     | .9630   | .9398          |           |         |
| Flange..... | 2.3150         | .0220     | 2.2930  | 2.2628         | .0200     | 2.2428  |
| Plug.....   | 2.2830         | .0220     | 2.2610  | 2.2328         |           |         |

<sup>12</sup> Some types of explosives and other dangerous materials are transported in containers having a special form of flange and plug. The dimensions of the straight screw threads of these parts are established by the Interstate Commerce Commission. The thread form is that developed by the Manufacturing Chemists Association of the United States. Its principal dimensions are:

Form of Thread: Angle, 60°; depth of thread, 0.0933 in.; and radius of crest and root, 0.0075 in.

Internal Screw Thread in Flange: threads per inch, 8; pitch diameter, 2.2067 in.; maximum major diameter, 2.305; minimum major diameter, 2.295 in.; maximum minor diameter, 2.1184 in.; and minimum minor diameter, 2.1084 in.; length of thread, 1 1/2 in.

External Screw Thread on Plug: Pitch diameter, 2.1887 in.; maximum major diameter, 2.287 in.; minimum major diameter, 2.277 in.; maximum minor diameter, 2.1004 in.; minimum minor diameter, 2.0904 in.; length of thread, 1 1/2 plus 1/2 in. gage

Large tolerances in addition to the allowance have been provided to ensure easy seating of the plug in the flange when making up the joint with a proper gasket.

## 6. TAPER AND STRAIGHT THREADS FOR RIGID STEEL ELECTRICAL CONDUIT AND FITTINGS

1. GENERAL.—Tables 7.6 and 7.7 give the principal thread data used in the production of rigid steel electrical conduit and fittings. These data were taken from the publications of the conduit manufacturers, the Underwriters Laboratories, and the National Electrical Manufacturers Association. They are also published in American Standards ASA C80.1-1959 Rigid Steel Conduit, Zinc coated and C80.2-1959 Rigid Steel Conduit, Enamelled. In certain places slight adjustments have been made to bring the dimensions in line with the long established pipe thread practice. In every case these adjustments have been discussed with the interested group. The sole purpose of the printing of these data is to show their relation to the original standard and to make them generally available.

2. TAPER THREADS FOR CONDUIT.—The taper threads on rigid steel conduit shown in table 7.6 are generally made in accordance with table VII.2. Table 7.6 records the dimensions commonly referred to for the conduit thread. When screw threads are cut by hand on rigid-steel conduit at the job, regular pipe fitter's stocks and dies (pipe threading tools) are used.

3. STRAIGHT EXTERNAL RUNNING THREADS.—The straight external running threads for conduit as used for fixture stems and conduit fittings are made in accordance with the dimensions given in table 7.7, columns 1 and 2.

4. STRAIGHT INTERNAL THREADS.—The straight internal threads used in conduit fittings are shown in table 7.7. These threads are made with the American standard pipe thread form.

## 7. PITCH DIAMETERS OF TAPER PIPE THREADS SHOWN IN THEIR RELATION TO E<sub>i</sub>

Pitch diameters of taper pipe threads are shown in their relation to E<sub>i</sub>, basic pitch diameter, in table 7.8.

## 8. SPECIAL SHORT, PTF-SPL SHORT; SPECIAL EXTRA SHORT, PTF-SPL EXTRA SHORT; FINE THREAD, F-PTF; AND SPECIAL DIAMETER-PITCH COMBINATION, SPL-PTF, DRYSEAL PIPE THREADS

1. GENERAL.—Included in this portion of the appendix are data on the following threads:

DRYSEAL SPECIAL SHORT TAPER PIPE THREAD, PTF-SPL SHORT. (Par. 2)

DRYSEAL SPECIAL EXTRA SHORT TAPER PIPE THREAD, PTF-SPL EXTRA SHORT (Par. 3)

DRYSEAL FINE THREAD SERIES, F-PTF (Par. 6)

DRYSEAL SPECIAL DIAMETER-PITCH COMBINATION SERIES, 27 threads per inch, SPL-PTF (Par. 7)

The SAE Dryseal pipe thread series are based on thread length. Full thread lengths and clearances for Dryseal standard and SAE SHORT series are shown in tables VIII.4, VIII.5, and VIII.6. These full thread lengths and clearances should be used in design applications wherever possible.

Design limitations, economy of material, permanent installation, or other limiting conditions may not permit the use of either of the full thread lengths and shoulder lengths in the preceding tables for the above thread series. To meet these conditions two special thread series have been established as shown in figure 7.2. The deviations from standard practice are described below.

2. DRYSEAL SPECIAL SHORT TAPER PIPE THREAD, PTF-SPL SHORT.—Threads of this series conform in all respects to the PTF-SAE SHORT threads except that the full thread length has been further shortened by eliminating one thread at the large end of external threads or eliminating one thread at the small end of internal threads.

**TABLE 7.6.—Dimensions of taper external and internal threads for rigid steel electrical conduit and conduit fittings (taper: 1/8 inch per foot on the diameter)**

| Nominal or trade size of conduit | Threads per inch | External threads                                      |                  |                 | Internal threads                                                                  |       |
|----------------------------------|------------------|-------------------------------------------------------|------------------|-----------------|-----------------------------------------------------------------------------------|-------|
|                                  |                  | Pitch diameter at beginning of external thread, $E_1$ | Length of thread |                 | Gaged with American Standard taper pipe thread (NPT) plug gage (See table VII. 9) |       |
|                                  |                  |                                                       | Effective, $L_1$ | Over-all, $L_2$ |                                                                                   |       |
| 1                                | 2                | 3                                                     | 4                | 5               | 6                                                                                 | 7     |
| <i>in.</i>                       |                  | <i>in.</i>                                            | <i>in.</i>       | <i>in.</i>      |                                                                                   |       |
| 1/16.....                        | 27               | 0.3635                                                | 0.20             | 0.30            | 5/16                                                                              | 8 1/4 |
| 1/8.....                         | 18               | .4774                                                 | .40              | .50             | 5/8                                                                               | 8 1/4 |
| 3/16.....                        | 18               | .6120                                                 | .41              | .60             | 6                                                                                 | 9     |
| 1/4.....                         | 14               | .7884                                                 | .53              | .78             | 6                                                                                 | 9     |
| 5/16.....                        | 14               | .9677                                                 | .55              | .79             | 6                                                                                 | 9     |
| 1.....                           | 11 1/4           | 1.2136                                                | .66              | .96             | 6                                                                                 | 9     |
| 1 1/4.....                       | 11 1/4           | 1.5571                                                | .71              | 1.01            | 6                                                                                 | 10    |
| 1 1/2.....                       | 11 1/4           | 1.7961                                                | .72              | 1.03            | 6                                                                                 | 10    |
| 2.....                           | 11 1/4           | 2.2090                                                | .76              | 1.06            | 6                                                                                 | 10    |
| 2 1/2.....                       | 8                | 2.7195                                                | 1.14             | 1.57            | 6                                                                                 | 10    |
| 3.....                           | 8                | 3.3406                                                | 1.20             | 1.63            | 6                                                                                 | 10    |
| 3 1/2.....                       | 8                | 3.8375                                                | 1.25             | 1.68            | 7                                                                                 | 11    |
| 4.....                           | 8                | 4.3344                                                | 1.30             | 1.73            | 7                                                                                 | 11    |
| 5.....                           | 8                | 5.3907                                                | 1.41             | 1.84            | 7                                                                                 | 11    |
| 6.....                           | 8                | 6.4461                                                | 1.51             | 1.95            | 7                                                                                 | 11    |

NOTES.—Tolerance on pitch diameter of taper thread and over-all thread length,  $L_2$ : The maximum allowable variation in the commercial product is one turn large and one turn small from the gaging notch on plug and gaging face of ring when using working gages. This is equivalent to a maximum allowable variation of the product of one and one-half turns large or small from the basic dimensions. The extra half turn is due to the permissible allowance of one-half turn large or small on working gages.

The dimensions shown in columns 3, 4, and 5 agree with those shown in columns 5, 9, and 17 of table VII.2, p. 5.

**TABLE 7.7.—Dimensions of straight external and internal threads for rigid steel electrical conduit, conduit bushings and other fittings, and locknuts**

| Nominal or trade size of conduit | Threads per inch | External threads, pitch diameter |            | Internal threads, pitch diameter |            |            |            |
|----------------------------------|------------------|----------------------------------|------------|----------------------------------|------------|------------|------------|
|                                  |                  | Max                              | Min        | Bushings and other fittings      |            | Locknuts   |            |
|                                  |                  |                                  |            | Min                              | Max        | Min        | Max        |
| 1                                | 2                | 3                                | 4          | 5                                | 6          | 7          | 8          |
| <i>in.</i>                       |                  | <i>in.</i>                       | <i>in.</i> | <i>in.</i>                       | <i>in.</i> | <i>in.</i> | <i>in.</i> |
| 1/16.....                        | 14               | 0.776                            | 0.770      | 0.781                            | 0.788      | 0.801      | 0.808      |
| 1/8.....                         | 14               | .967                             | .961       | .992                             | .999       | 1.011      | 1.018      |
| 1.....                           | 11 1/4           | 1.236                            | 1.228      | 1.244                            | 1.252      | 1.266      | 1.274      |
| 1 1/4.....                       | 11 1/4           | 1.561                            | 1.573      | 1.588                            | 1.596      | 1.611      | 1.619      |
| 1 1/2.....                       | 11 1/4           | 1.820                            | 1.812      | 1.827                            | 1.835      | 1.850      | 1.858      |
| 2.....                           | 11 1/4           | 2.294                            | 2.286      | 2.301                            | 2.309      | 2.323      | 2.332      |
| 2 1/2.....                       | 8                | 2.758                            | 2.748      | 2.769                            | 2.781      | 2.801      | 2.813      |
| 3.....                           | 8                | 3.385                            | 3.375      | 3.396                            | 3.408      | 3.428      | 3.439      |
| 3 1/2.....                       | 8                | 3.885                            | 3.875      | 3.896                            | 3.908      | 3.928      | 3.940      |
| 4.....                           | 8                | 4.383                            | 4.373      | 4.394                            | 4.406      | 4.426      | 4.438      |
| 5.....                           | 8                | 5.445                            | 5.435      | 5.456                            | 5.468      | 5.488      | 5.500      |
| 6.....                           | 8                | 6.502                            | 6.492      | 6.513                            | 6.525      | 6.545      | 6.557      |

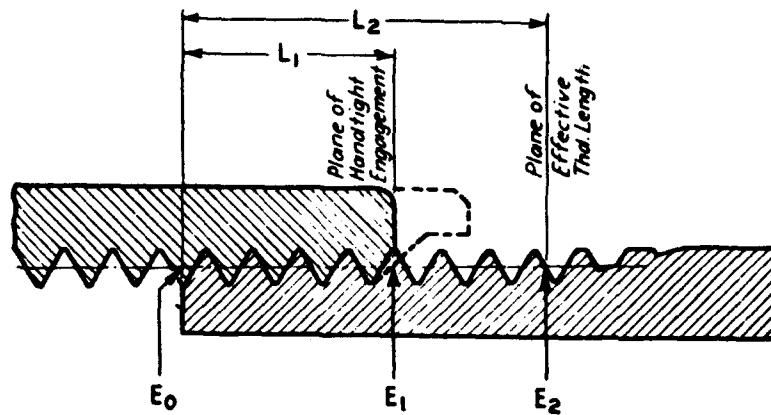
All dimensions are after plating.

The column 3 values are the column 8 values of table VII.2, p. 5, minus 0.0022 for the 14 tpi threads, minus 0.0026 for the 11 1/4 tpi threads, and minus 0.0039 for the 8 tpi threads, rounded to three decimal places.

The column 5 values are the same as the column 8 values of table VII.2, p. 5, plus 0.003 for the 14 tpi threads, plus 0.005 for the 11 1/4 tpi threads, and plus 0.007 for the 8 tpi threads, rounded to three decimal places.

The column 7 and 8 values are the column 7 and 8 values of table VII.7, p. 10, rounded to three decimal places.

TABLE 7.8.—Pitch diameters of taper pipe threads shown in their relation to  $E_1$



| Nominal pipe size | Length<br>$L_1$ in<br>turns | Pitch<br>diam-<br>eter<br>at $E_0$ | Number of turns—small |         |         |         |         |         |         |         | Basic<br>pitch<br>diam-<br>eter, $E_1$ |
|-------------------|-----------------------------|------------------------------------|-----------------------|---------|---------|---------|---------|---------|---------|---------|----------------------------------------|
|                   |                             |                                    | 7                     | 6       | 5       | 4       | 3       | 2       | 1½      | 1       |                                        |
|                   |                             |                                    | Pitch diameter        |         |         |         |         |         |         |         |                                        |
| 1                 | 2                           | 3                                  | 4                     | 5       | 6       | 7       | 8       | 9       | 10      | 11      | 12                                     |
| in.               |                             | in.                                | in.                   | in.     | in.     | in.     | in.     | in.     | in.     | in.     | in.                                    |
| ¾                 | 4.32                        | 0.27118                            |                       |         |         | 0.27194 | 0.27425 | 0.27656 | 0.27772 | 0.27887 | 0.28118                                |
| ¾                 | 4.36                        | .36351                             |                       |         |         | .36436  | .36667  | .36898  | .37014  | .37129  | .37360                                 |
| 1                 | 4.10                        | .47739                             |                       |         |         | *.47774 | .48122  | .48469  | .48642  | .48816  | .49163                                 |
| 1¼                | 4.32                        | .61201                             |                       |         |         | .61312  | .61660  | .62007  | .62180  | .62354  | .62701                                 |
| 1½                | 4.48                        | .75843                             |                       |         |         | .76039  | .76305  | .76651  | .77174  | .77397  | .77843                                 |
| 2                 |                             |                                    |                       |         |         |         |         |         |         |         |                                        |
| 2½                | 4.75                        | .96768                             |                       |         |         | .97103  | .97549  | .97995  | .98218  | .98441  | *.98887                                |
| 3                 | 4.60                        | 1.21363                            |                       |         |         | 1.21691 | 1.22234 | 1.22777 | 1.23049 | 1.23320 | 1.23695                                |
| 3½                | 4.83                        | 1.55713                            |                       |         |         | 1.56166 | 1.56709 | 1.57252 | 1.57524 | 1.57795 | 1.58338                                |
| 4                 | 4.83                        | 1.79609                            |                       |         |         | 1.80062 | 1.80605 | 1.81148 | 1.81420 | 1.81691 | 1.82234                                |
| 4½                | 5.01                        | 2.26902                            |                       |         | 2.26912 | 2.27455 | 2.27998 | 2.28541 | 2.28813 | 2.29084 | 2.29627                                |
| 5                 |                             |                                    |                       |         |         |         |         |         |         |         |                                        |
| 5½                | 5.45                        | 2.71953                            |                       |         | 2.72311 | 2.72892 | 2.73573 | 2.74654 | 2.75045 | 2.75435 | 2.76216                                |
| 6                 | 6.12                        | 3.34053                            |                       | 3.34164 | 3.34945 | 3.35726 | 3.36507 | 3.37288 | 3.37679 | 3.38069 | 3.38850                                |
| 6½                | 6.56                        | 3.83750                            |                       | 3.83195 | 3.84976 | 3.85757 | 3.86538 | 3.87319 | 3.87710 | 3.88100 | 3.88881                                |
| 7                 | 6.76                        | 4.33438                            |                       | 4.34027 | 4.34808 | 4.35589 | 4.36370 | 4.37151 | 4.37542 | 4.37932 | 4.38713                                |
| 7½                | 7.50                        | 5.39073                            | 5.39462               | 5.40243 | 5.41024 | 5.41805 | 5.42586 | 5.43367 | 5.43758 | 5.44148 | 5.44929                                |
| 8                 | 7.67                        | 6.44609                            | 6.45130               | 6.45911 | 6.46692 | 6.47473 | 6.48254 | 6.49035 | 6.49426 | 6.49816 | 6.50697                                |

| Basic pitch diameter, $E_1$ | Number of turns—large |         |         |         |         | Pitch diameter at $E_1$ | Length $L_2-L_1$ in turns | Increase in pitch diameter per turn | Pitch of thread | Nominal pipe size |
|-----------------------------|-----------------------|---------|---------|---------|---------|-------------------------|---------------------------|-------------------------------------|-----------------|-------------------|
|                             | 1                     | 1½      | 2       | 3       | 4       |                         |                           |                                     |                 |                   |
|                             | Pitch diameter        |         |         |         |         |                         |                           |                                     |                 |                   |
| 13                          | 14                    | 15      | 16      | 17      | 18      | 19                      | 20                        | 21                                  | 22              | 23                |
| in.                         | in.                   | in.     | in.     | in.     | in.     | in.                     |                           | in.                                 | in.             | in.               |
| 0.28118                     | 0.28349               | 0.28464 | 0.28580 |         |         | 0.28750                 | 2.73                      | 0.00231                             | 0.03704         | ¾                 |
| 0.37360                     | .37591                | .37707  | .37822  |         |         | .38000                  | 2.76                      | .00231                              | .03704          | ¾                 |
| 0.49163                     | .49510                | .49684  | .49857  | 0.50204 |         | .50250                  | 3.13                      | .00347                              | .05556          | 1                 |
| 0.62701                     | .63048                | .63222  | .63395  | .63742  |         | .63750                  | 3.02                      | .00347                              | .05556          | ¾                 |
| 0.77843                     | .78289                | .78512  | .78735  |         |         | .79179                  | 2.99                      | .00446                              | .07143          | ½                 |
| *0.98887                    | .99333                | .99556  | .99779  |         |         | 1.00179                 | 2.89                      | .00446                              | .07143          | ¾                 |
| 1.23695                     | 1.24406               | 1.24678 | 1.24949 | 1.25492 |         | 1.25630                 | 3.25                      | .00543                              | .08996          | 1                 |
| 1.58338                     | 1.58881               | 1.59153 | 1.59424 | 1.59967 |         | 1.60130                 | 3.30                      | .00543                              | .08996          | 1½                |
| 1.82234                     | 1.82777               | 1.83049 | 1.83320 | 1.83863 |         | 1.84130                 | 3.49                      | .00543                              | .08996          | 1½                |
| 2.29627                     | 2.30170               | 2.30442 | 2.30713 | 2.31256 |         | 2.31630                 | 3.69                      | .00543                              | .08996          | 2                 |
| 2.76216                     | 2.76997               | 2.77388 | 2.77778 | 2.78559 |         | 2.79062                 | 3.64                      | .00781                              | .12500          | 2½                |
| 3.38850                     | 3.39631               | 3.40022 | 3.40412 | 3.41193 |         | 3.41582                 | 3.47                      | .00781                              | .12500          | 3                 |
| 3.88881                     | 3.89662               | 3.90053 | 3.90443 | 3.91224 |         | 3.91582                 | 3.43                      | .00781                              | .12500          | 3½                |
| 4.38713                     | 4.39494               | 4.39885 | 4.40275 | 4.41056 |         | 4.41582                 | 3.64                      | .00781                              | .12500          | 4                 |
| 5.44929                     | 5.45710               | 5.46101 | 5.46491 | 5.47272 |         | 5.47862                 | 3.76                      | .00781                              | .12500          | 5                 |
| 6.50697                     | 6.51378               | 6.51769 | 6.52159 | 6.52940 | 6.53721 | 6.54062                 | 4.44                      | .00781                              | .12500          | 6                 |

Gaging is the same as for PTF-SAE SHORT except the  $L_1$  ring thread gage for external thread length and taper or the  $L_2$  plug thread gage for internal thread length and taper cannot be used. The tolerance must be altered as described in paragraph 4 below on Limitations of Assembly. For interchangeability, see table 7.9. This thread shall be designated as follows:

#### $\frac{1}{4}$ -27 DRYSEAL PTF-SPL SHORT.

3. DRYSEAL SPECIAL EXTRA SHORT TAPER PIPE THREAD, PTF-SPL EXTRA SHORT.—Threads of this series conform in all respects to the PTF-SAE SHORT threads except that the full thread length has been further shortened by eliminating two threads at the large end of external threads or eliminating two threads at the small end of internal threads. Gaging is the same as for PTF-SAE SHORT except the  $L_2$  ring thread gage for external thread length and taper or the  $L_3$  plug thread gage for internal thread length and taper cannot be used. The tolerance must be altered as described in paragraph 4 below on Limitations of Assembly. For interchangeability, see table 7.9. This thread shall be designated as follows:

#### $\frac{1}{4}$ -27 DRYSEAL PTF-SPL EXTRA SHORT.

4. LIMITATIONS OF ASSEMBLY FOR DRYSEAL PTF-SPL SHORT AND PTF-SPL EXTRA SHORT THREADS.—Combinations of the standard Dryseal pipe threads are given in table VIII.3, page 21. However, where special combinations are used, additional considerations must be observed. In addition to "SPL" in the designation, the gaging tolerance should be specified.

5. INTERCHANGEABILITY BETWEEN DRYSEAL SPECIAL AND DRYSEAL STANDARD THREADS.—Interchangeability between Dryseal special and Dryseal standard threads of section VIII, is given in table 7.9.

6. DRYSEAL FINE THREAD SERIES, F-PTF.—The need for finer pitches for nominal pipe sizes has brought into use applications of 27 threads per inch to  $\frac{1}{4}$  and  $\frac{1}{2}$  in. pipe sizes. There may be other needs which require finer pitches for larger pipe sizes. It is recommended that the existing threads per inch be applied to next size larger pipe size for a fine thread series such as are shown in table 7.10. This series applies to external and internal threads of full length and is suitable for applications where threads finer than NPTF are required. The designation for this thread should include the letter F and omit the letter N as follows:

#### $\frac{1}{4}$ -27 DRYSEAL F-PTF

7. DRYSEAL SPECIAL DIAMETER-PITCH COMBINATION SERIES, SPL-PTF.—Other applications of diameter-pitch combinations have also come into use where taper pipe threads are applied to nominal size thin wall tubing such as are shown in table 7.11. This series applies to external and internal threads of full length and is applicable to thin wall nominal outside diameter tubing. The number of threads is uniform at 27 per inch. The designation for this special series should include the abbreviation SPL for special and omit the letter N. Also, the outside diameter of the tubing should be given as follows:

#### $\frac{1}{2}$ -27 DRYSEAL SPL-PTF, O.D. 0.500

8. FORMULAS FOR DIAMETER AND LENGTH OF THREAD.—Basic diameter and length of thread for sizes of Dryseal fine taper pipe thread, F-PTF, and Dryseal special taper pipe thread, SPL-PTF, given in tables 7.10 and 7.11 are based on the following formulas:

$D$ =outside diameter of pipe or tubing in inches  
 $p$ =pitch of thread in inches  
 Diametral taper=0.75 in. per 12.00 in. of length

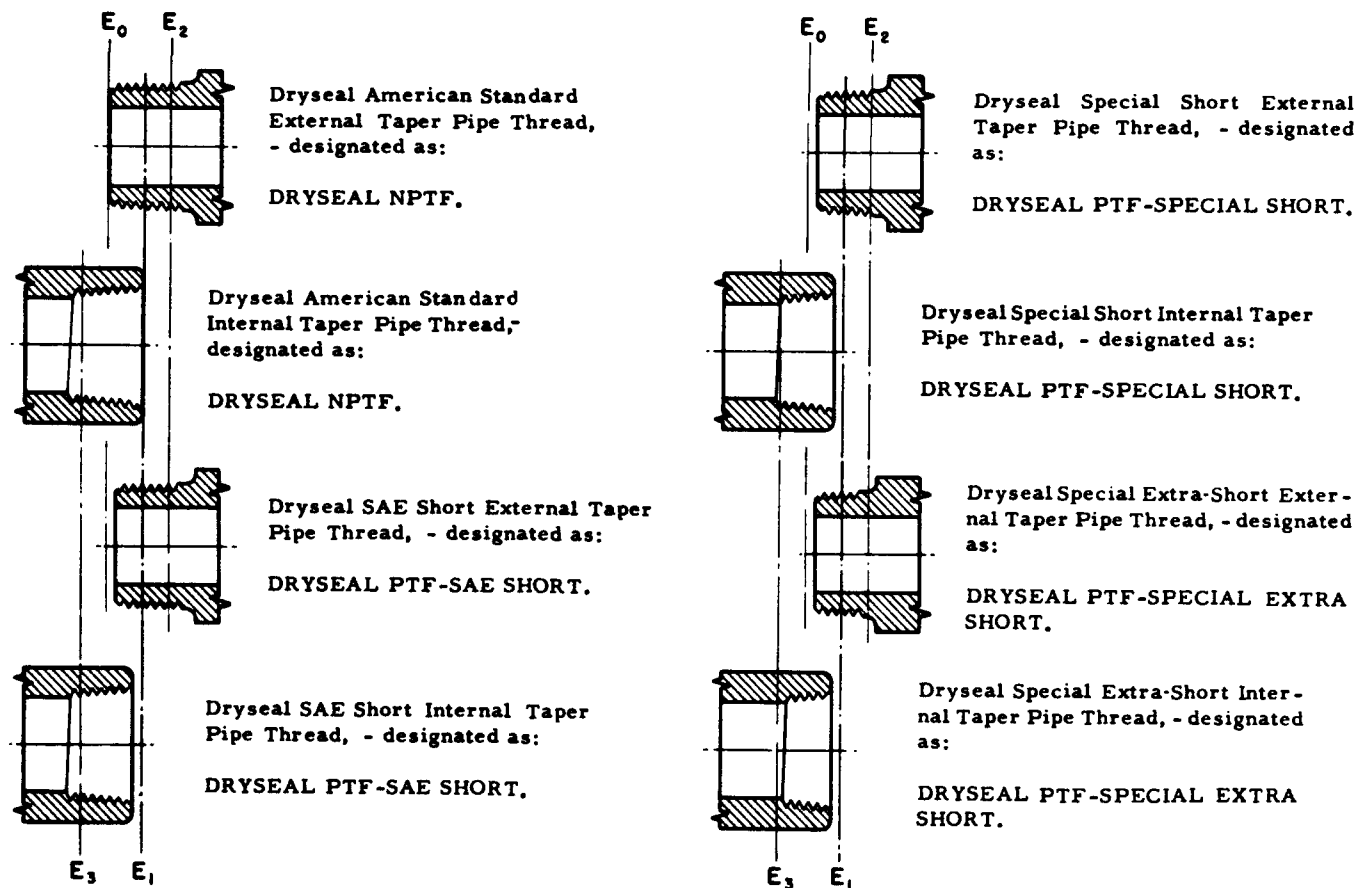


FIGURE 7.2.—Comparison of special length Dryseal threads with standard length Dryseal threads.

TABLE 7.9.—\* Recommended limitation of assembly among Dryseal special and Dryseal standard threads

|                                                            |                              |                                                                                                           |
|------------------------------------------------------------|------------------------------|-----------------------------------------------------------------------------------------------------------|
| PTF-SPL SHORT, external.<br>PTF-SPL EXTRA SHORT, external. | May * as-<br>semble<br>with— | PTF-SAE SHORT, internal.<br>NPSF, internal.<br>PTF-SPL SHORT, internal.<br>PTF-SPL EXTRA SHORT, internal. |
| PTF-SPL SHORT, internal.<br>PTF-SPL EXTRA SHORT, internal. | May * as-<br>semble<br>with— | PTF-SAE SHORT, external.                                                                                  |
| PTF-SPL SHORT, external.<br>PTF-SPL EXTRA SHORT, external. | May * as-<br>semble<br>with— | NPTF, internal.<br>NPSI, internal.                                                                        |
| PTF-SPL SHORT, internal.<br>PTF-SPL EXTRA SHORT, internal. | May * as-<br>semble<br>with— | NPTF, external.                                                                                           |

\* Only when the external thread or the internal thread or both are held closer than the standard tolerance, the external toward the minimum and the internal toward the maximum pitch diameter to provide a minimum of one turn hand engagement. At extreme tolerance limits the shortened full thread lengths reduce hand engagement and the threads may not start.

\* Only when both the internal thread and the external thread are held closer than the standard tolerance, the internal toward the minimum and the external toward the maximum pitch diameter to provide a minimum of two turns for wrench makeup and sealing. At extreme tolerance limits the shortened full thread lengths reduce wrench makeup and the threads may not seal.

Basic pitch diameter at small end of external thread:

$$E_0 = D - (0.05D + 1.1)p.$$

Basic pitch diameter at large end of internal thread:

$$E_1 = E_0 + 0.0625L_1 = D - 0.0625p.*$$

Basic pitch diameter at large end of external thread:

$$E_2 = E_0 + 0.0625L_2 = D - 0.675p.$$

Basic pitch diameter at small end of internal thread:

$$E_3 = E_0 - 0.0625L_3 = D - (0.05D + 1.2875)p.$$

Basic length of thread for hand engagement:

$$L_1 = (0.8D + 3.8)p.$$

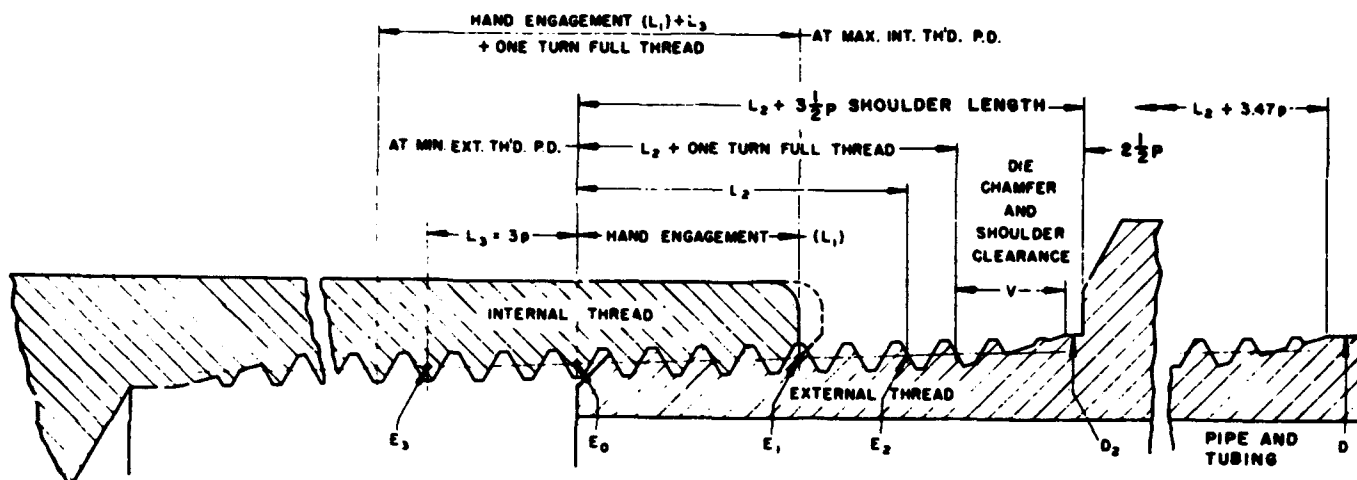
Basic length of full and effective thread:

$$L_2 = (0.8D + 6.8)p.$$

Basic length of internal thread from end of hand engagement,  $E_0$ , to small end of internal thread,  $E_3$ :

$$L_3 = 3p.$$

TABLE 7.10.—Basic dimensions of Dryseal fine taper pipe thread, F-PTF



| Size     | Pitch, $p$ | Pitch diameter at small end of external thread, $E_0$ | Pitch diameter at large end of internal thread, $E_1$ | Pitch diameter at large end of external thread, $E_2$ | Pitch diameter at small end of internal thread, $E_3$ | Hand engagement, $L_1$ |             | Internal basic $\ast$ , full thread length, $(L_1 + L_2)$ , and external basic full thread length, $L_2$ |             | Vanish thds, $V$ , plus thd. tol. plus shoulder clearance, $(V + 3/2p)$ |             | Shoulder length, $(L_2 + 3\frac{1}{2}p)$ | Thread for draw |             | Outside diameter of fitting, $D_1$ | Outside diameter of pipe, $D$ |
|----------|------------|-------------------------------------------------------|-------------------------------------------------------|-------------------------------------------------------|-------------------------------------------------------|------------------------|-------------|----------------------------------------------------------------------------------------------------------|-------------|-------------------------------------------------------------------------|-------------|------------------------------------------|-----------------|-------------|------------------------------------|-------------------------------|
| 1        | 2          | 3                                                     | 4                                                     | 5                                                     | 6                                                     | 7                      | 8           | 9                                                                                                        | 10          | 11                                                                      | 12          | 13                                       | 14              | 15          | 16                                 | 17                            |
|          | <i>in.</i> | <i>in.</i>                                            | <i>in.</i>                                            | <i>in.</i>                                            | <i>in.</i>                                            | <i>in.</i>             | <i>thds</i> | <i>in.</i>                                                                                               | <i>thds</i> | <i>in.</i>                                                              | <i>thds</i> | <i>in.</i>                               | <i>in.</i>      | <i>thds</i> | <i>in.</i>                         | <i>in.</i>                    |
| 14-27    | 0.03704    | 0.49826                                               | 0.50907                                               | 0.51501                                               | 0.49132                                               | 0.157                  | 4.23        | 0.268                                                                                                    | 7.23        | 0.1296                                                                  | 3.5         | 0.3975                                   | 0.1111          | 3.0         | 0.546                              | 0.540                         |
| 1/2-27   | 0.03704    | 0.63301                                               | 0.64307                                               | 0.65001                                               | 0.62907                                               | 0.161                  | 4.34        | 0.272                                                                                                    | 7.34        | 0.1296                                                                  | 3.5         | 0.4015                                   | 0.1111          | 3.0         | 0.681                              | 0.675                         |
| 1/2-18   | 0.05556    | 0.77655                                               | 0.79205                                               | 0.80249                                               | 0.78613                                               | 0.248                  | 4.47        | 0.415                                                                                                    | 7.47        | 0.1944                                                                  | 3.5         | 0.6066                                   | 0.1667          | 3.0         | 0.850                              | 0.840                         |
| 3/4-18   | 0.05556    | 0.98597                                               | 1.00210                                               | 1.01247                                               | 0.97555                                               | 0.258                  | 4.64        | 0.424                                                                                                    | 7.64        | 0.1944                                                                  | 3.5         | 0.6189                                   | 0.1667          | 3.0         | 1.000                              | 1.000                         |
| 1-14     | 0.07143    | 1.23173                                               | 1.25342                                               | 1.26679                                               | 1.21834                                               | 0.347                  | 4.85        | 0.561                                                                                                    | 7.85        | 0.2500                                                                  | 3.5         | 0.8109                                   | 0.2143          | 3.0         | 1.327                              | 1.315                         |
| 1 1/4-14 | 0.07143    | 1.57550                                               | 1.59637                                               | 1.61181                                               | 1.56211                                               | 0.366                  | 5.13        | 0.581                                                                                                    | 8.13        | 0.2500                                                                  | 3.5         | 0.8306                                   | 0.2143          | 3.0         | 1.672                              | 1.660                         |
| 1 1/2-14 | 0.07143    | 1.81464                                               | 1.83839                                               | 1.85176                                               | 1.80125                                               | 0.380                  | 5.32        | 0.594                                                                                                    | 8.32        | 0.2500                                                                  | 3.5         | 0.8443                                   | 0.2143          | 3.0         | 1.912                              | 1.900                         |
| 2-14     | 0.07143    | 2.28794                                               | 2.31338                                               | 2.32675                                               | 2.27455                                               | 0.407                  | 5.70        | 0.621                                                                                                    | 8.70        | 0.2500                                                                  | 3.5         | 0.8714                                   | 0.2143          | 3.0         | 2.387                              | 2.375                         |

\* Tabulated external basic full thread lengths include chamfers not exceeding one \* and one-half pitches (threads) length. Design size full thread length should equal the external basic full thread length plus one pitch.

\* Tabulated internal basic full thread lengths do not include countersink

beyond the intersection of the pitch line and the chamfer cone (gaging reference point). Design size full thread length should equal the internal basic full thread length plus one pitch.

Tolerance shall be equal to plus or minus the taper of one thread on the diameter.

### 9. SUPERSEDED GAGE DIMENSIONS AND GAGING PRACTICE FOR 1/8 AND 1/4 SIZE DRYSEAL PIPE THREADS

\* In this standard, the  $L_1$  dimensions for the 1/8-27 and 1/4-18 sizes were revised to correct for a disproportionate number of threads for hand engagement. The  $L_1$  hand engagement dimensions affecting gages in tables VII.2, VII.9, VIII.15, VIII.16, and VIII.17 were revised to agree with the product dimensions for future gage procurement.

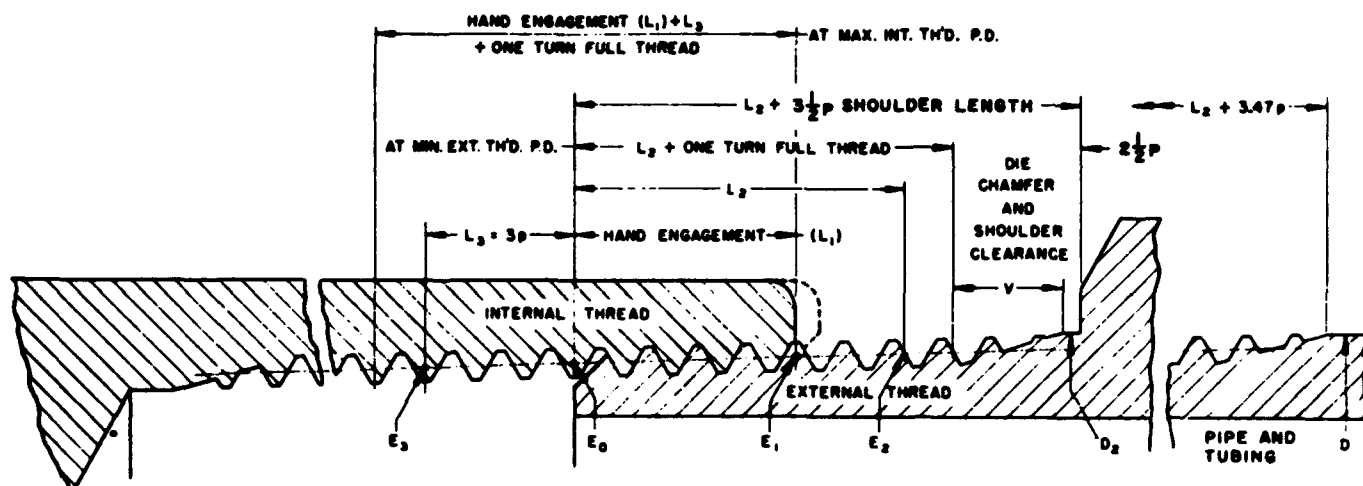
Therefore, it should be noted that where basic-notch thread gages having superseded dimensions (see table 7.12) are being used for gaging the 1/8-27 and 1/4-18 sizes, the formerly observed deviations from specified gaging practice should be applied as follows:

Internal threads gaged by the Position Method should be 1/2 turn smaller for the 1/8-27 size and 1/2 turn larger for the 1/4-18 size than the specified PD gaging steps.

External threads gaged by the Turns Engagement Method should be 1/2 turn greater for the 1/8-27 size and 1/2 turn less for the 1/4-18 size than the basic turns specified.

Table 7.12 lists the dimensions related to the superseded  $L_1$  dimensions of 0.1800 for the 1/8-27 size and 0.2000 for the 1/4-18 size.

TABLE 7.11.—Basic dimensions of Dryseal special taper pipe thread, SPL-PTF (for thin wall nominal size OD tubing)



| Tubing - diameter, $D$ | Threads per inch | Pitch, $p$ | Pitch diameter at small end of external thd, $E_3$ | Pitch diameter at large end of internal thd, $E_1$ | Pitch diameter at large end of external thd, $E_2$ | Pitch diameter at small end of internal thd, $E_3$ | Hand engagement, $L_1$ |     | Internal basic full thread length, ( $L_1 + L_2$ ), and external basic full thread length, $L_1$ |     | Thread for draw |     |
|------------------------|------------------|------------|----------------------------------------------------|----------------------------------------------------|----------------------------------------------------|----------------------------------------------------|------------------------|-----|--------------------------------------------------------------------------------------------------|-----|-----------------|-----|
|                        |                  |            |                                                    |                                                    |                                                    |                                                    | 8                      | 9   | 10                                                                                               | 11  | 12              | 13  |
| in.                    |                  | in.        | in.                                                | in.                                                | in.                                                | in.                                                | in.                    | ths | in.                                                                                              | ths | in.             | ths |
| 1/2                    | 27               | 0.03704    | 0.45833                                            | 0.46806                                            | 0.47500                                            | 0.45139                                            | 0.1556                 | 4.2 | 0.2667                                                                                           | 7.2 | 0.1111          | 3.0 |
| 3/4                    | 27               | 0.03704    | 0.58310                                            | 0.59306                                            | 0.60000                                            | 0.57616                                            | 0.1583                 | 4.3 | 0.2704                                                                                           | 7.3 | 0.1111          | 3.0 |
| 1                      | 27               | 0.03704    | 0.70787                                            | 0.71806                                            | 0.72500                                            | 0.70088                                            | 0.1630                 | 4.4 | 0.2741                                                                                           | 7.4 | 0.1111          | 3.0 |
| 1 1/4                  | 27               | 0.03704    | 0.83264                                            | 0.84306                                            | 0.85000                                            | 0.82570                                            | 0.1667                 | 4.5 | 0.2778                                                                                           | 7.5 | 0.1111          | 3.0 |
| 1 1/2                  | 27               | 0.03704    | 0.95740                                            | 0.96806                                            | 0.97500                                            | 0.95046                                            | 0.1704                 | 4.6 | 0.2815                                                                                           | 7.6 | 0.1111          | 3.0 |

NOTE—Dimensions of other combinations of diameter and pitch, in addition to those listed above, may be developed by use of the formulas.

\* This denotes nominal outside diameter of tubing and should not be confused with nominal pipe diameter and thread designations.

\* Tabulated external basic full thread lengths include chamfers not exceed-

ing one \* and one-half pitches (threads) length. Design size full thread length should equal the external basic full thread length plus one pitch.

\* Tabulated internal basic full thread lengths do not include countersink beyond the intersection of the pitch line and the chamfer cone (gaging reference point). Design size full thread length should equal the internal basic full thread length plus one pitch.

TABLE 7.12.—Dimensions \* related to superseded dimensions of  $L_1$  equals 0.1800 for the  $\frac{1}{8}$ —27 size and 0.2000 for the  $\frac{1}{4}$ —18 size

| Size              | Pitch diameter at $L_1-p$ , $E_s$ | Minor diameter at $L_1-p$ | $L_1-p$        | Handtight engagement, $L_1$ | Pitch diameter, $E_1$ | Minor diameter at $L_1$ | Major diameter at $L_1$ | $L_1+L_1$     |
|-------------------|-----------------------------------|---------------------------|----------------|-----------------------------|-----------------------|-------------------------|-------------------------|---------------|
| 1                 | 2                                 | 3                         | 4              | 5                           | 6                     | 7                       | 8                       | 9             |
| $\frac{1}{8}$ —27 | in.<br>0.37244                    | in.<br>0.35518            | in.<br>0.14296 | in.<br>0.1800               | in.<br>0.37476        | in.<br>0.35750          | in.<br>0.39202          | in.<br>0.2011 |
| $\frac{1}{4}$ —18 | in.<br>.48642                     | in.<br>.46063             | in.<br>.14444  | in.<br>.2000                | in.<br>.48888         | in.<br>.46400           | in.<br>.51578           | in.<br>.2667  |

## APPENDIX 8. GEOMETRY OF TAPER SCREW THREADS

### 1. INTRODUCTION

This appendix presents several geometrical relationships relative to the conical spiral, which is the curve of generation of the taper screw thread, and also briefly discusses the conical helix. With reference to these curves, the formulas include the parametric equations, the projection, the development, the lead angle, and length of an arc.

The geometry of taper screw threads has, in practice, developed by modification of the geometry of straight screw threads, with the result that formulas commonly used for taper screw threads are often approximations instead of being exact. That such approximations have been satisfactory in practice arises from the fact that the angle of taper, or cone angle, of standard taper threads has been small. The more recent use of larger taper angles together with the higher precision of measurement of screw thread gages now demanded, sometimes requires the availability of exact, or more nearly exact, formulas to be substituted for the approximate formulas or used to determine the magnitude of errors introduced by the usual approximations.

It is convenient to approach the subject by considering the nature of the curves of generation of straight screw threads and of taper screw threads, respectively, namely the cylindrical helix and the conical spiral.

A cylindrical helix may be defined in various ways. First it is a curve on the surface of a circular cylinder which cuts the elements of the cylinder at a constant angle. The same curve may also be defined as the curve generated by a point moving at a uniform rate along a straight line while the line revolves uniformly about an axis parallel to itself, so that successive intersections of the curve and an element of the cylinder are equally spaced. These definitions establish the fact that the cylindrical helix is both loxodromic and isometric.

There is no corresponding curve on the surface of a cone which simultaneously answers to both methods of generation. Thus there are two different spiral-shaped curves lying on the surface of a cone which are analogous to the circular helix, one of which is loxodromic and the other isometric. Mathematicians have agreed [6]<sup>13</sup> that the loxodromic curve corresponds to the definition of a general helix, and that it should properly be termed a conical helix. The isometric curve has been called the conical spiral. Loria [6] gives a brief history of this curve, stating that it is found in a work by B. Pascal and citing several 18th century references, one of which points out that the curve was known to ancient Greek geometers. Thus there are the following definitions:

A conical spiral is generated if a point travels on the surface of a right circular cone so as to combine a uniform angular motion around the axis of the cone with a uniform linear motion along a generator toward or from the vertex. It is characterized by uniformity of pitch, that is, successive intersections of the curve and an element of the cone are

equally spaced, and by the fact that it passes through the vertex of the cone. The conical spiral occurs in such mechanical applications as the taper screw thread, the spiral bevel gear [11], and the conical spring [12].

A conical helix is generated if a point travels on the surface of a right circular cone in such a way that the curve produced intersects the elements of the cone at a constant angle. The pitch of this curve varies from point to point and it approaches the vertex of the cone as an asymptote. It is applied mechanically in the conical spring [1, 7, 9] as sometimes made. (For conical springs with coils of constant slope it is desirable that the projection of the neutral axis of the spring be an Archimedes' spiral. Such a spring is not truly conical but is wound on a paraboloid of revolution.) [10]

The cylindrical helix is the curve of intersection of a helioid and a coaxial cylinder, and the conical spiral is the intersection of a helioid and a coaxial cone. Accordingly, although the geometry of the conical spiral differs from that of the helix, there is but one geometry of helioids. A screw helioid, for example, remains a screw helioid, whether the ends of its generatrix are determined by coaxial cylinders, as in straight screw threads, or by coaxial cones, as in taper screw threads. These different boundary conditions give rise, however, to certain different geometrical relations.

### 2. PARAMETRIC EQUATIONS OF THE CONICAL SPIRAL; THE PROJECTION, DEVELOPMENT, LEAD ANGLE, AND LENGTH OF AN ARC

The parametric equations of the conical spiral, with the vertex of the cone at the origin and the axis of the cone coinciding with the  $z$ -axis, as shown in figure 8.1, are:

$$\left. \begin{aligned} x &= \frac{L}{2\pi} \theta \tan \alpha \cos \theta \\ y &= \frac{L}{2\pi} \theta \tan \alpha \sin \theta \\ z &= \frac{L}{2\pi} \theta, \end{aligned} \right\} \quad (1)$$

where

$\alpha$  =  $\frac{1}{2}$  included angle between opposite elements of the cone,

$\theta$  = the variable parameter, and is the angle which the projection of the radius vector of the point on the conical spiral makes with the  $x$ -axis on the  $xy$ -plane,

$L$  = lead of spiral, or advance, parallel to the axis, in one revolution.

The length,  $r$ , of the radius vector at any point on the conical spiral is given by the relation:

$$r = \frac{L}{2\pi} \theta \sec \alpha. \quad (2)$$

<sup>13</sup> Numbers in brackets refer to similarly numbered items in the bibliography at the end of this appendix.

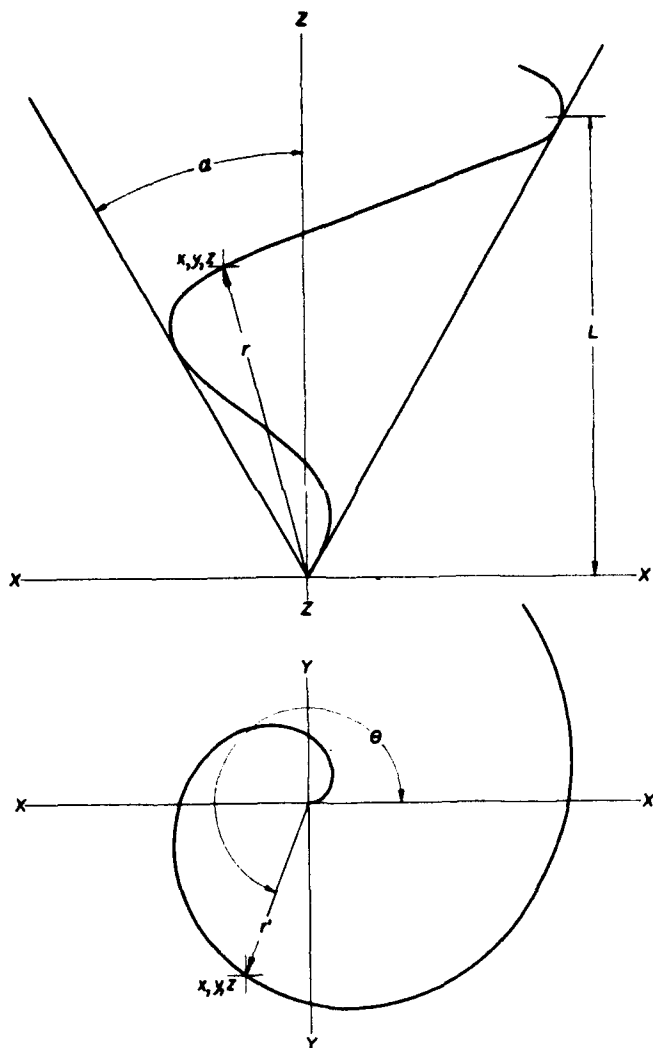


FIGURE 8.1.—The conical spiral.

The projection,  $r'$ , of the radius vector,  $r$ , on the  $xy$ -plane is given by the relation:

$$r' = \frac{L}{2\pi} \theta \tan \alpha. \quad (3)$$

This is the equation of a spiral of Archimedes, which is the projection of the conical spiral on the  $xy$ -plane.

The developed cylindrical helix is a straight line, which makes an angle,  $s$ , with the line perpendicular to the axis, such that,

$$\tan s = \frac{L}{2\pi r}. \quad (4)$$

The developed conical spiral is an Archimedes' spiral, derived from the equations for the conical spiral and represented by the equation:

$$\rho = \frac{L\phi}{\pi} \csc 2\alpha \quad (5)$$

where

$$\rho = \text{radius vector} = z \sec \alpha = \frac{L}{2\pi} \theta \sec \alpha$$

$$\phi = \text{vectorial angle} = \theta \sin \alpha.$$

The lead angle,  $s$ , defined as the angle made by the conical spiral at a given point with a plane perpendicular to the axis, is determined from the formula for the tangent line:

$$\tan s = \frac{\cot \alpha}{\sqrt{\theta^2 + 1}}. \quad (6)$$

This expression is of interest because the lead,  $L$ , is not directly involved. It shows that all isometric conical spirals at a given number of revolutions from the apex cut an element of the cone at the same angle, regardless of the pitch. Also, a conical spiral is tangent to an element of the cone at the apex.

The exact length,  $S_a$ , of the arc of a conical spiral subtended by the vectorial angle  $(\theta_2 - \theta_1)$ , is given by the expression:

$$S_a = \frac{L}{4\pi} \tan \alpha \left\{ \theta_2 \sqrt{\theta_2^2 + \csc^2 \alpha} - \theta_1 \sqrt{\theta_1^2 + \csc^2 \alpha} + \csc^2 \alpha \log \frac{\theta_2 + \sqrt{\theta_2^2 + \csc^2 \alpha}}{\theta_1 + \sqrt{\theta_1^2 + \csc^2 \alpha}} \right\}. \quad (7)$$

An approximation of the value of  $S_a$ , which is exact for the cylindrical helix and sufficiently close to the exact value for the conical spiral for most practical purposes, is given by the relation:

$$S_a = \sqrt{\pi^2 (r'_1 + r'_2)^2 + L^2} \quad (8)$$

where  $r'_1$  and  $r'_2$  are the projections of the radii vectores corresponding to  $\theta_1$  and  $\theta_2$ .

### 3. PARAMETRIC EQUATIONS OF THE CONICAL HELIX; THE PROJECTION, DEVELOPMENT, LEAD ANGLE, AND LENGTH OF AN ARC

The properties of the conical helix, which is defined above, have been discussed by Dieu [5], Resal [8], and others [1, 2, 6]. Some of the more important analytical relations are here presented.

Taking, as for the conical spiral, the vertex of the cone as the origin, and the axis of the cone as the  $z$ -axis, figure 8.2, the general parametric equations, and the equation of the radius vector, of the conical helix, are:

$$\left. \begin{aligned} x &= c e^{a\theta} \cos \theta \\ y &= c e^{a\theta} \sin \theta \\ z &= b e^{a\theta} \end{aligned} \right\} \quad (9)$$

$$r = \sqrt{b^2 + c^2} e^{a\theta} \quad (10)$$

where  $a$ ,  $b$ , and  $c$  are constants,  $e$  is the natural logarithmic base, 2.71828,  $\theta$  is the variable parameter, and  $r$  is the radius vector.

This curve, unlike the conical spiral, approaches the origin as an asymptotic point, the successive turns about the cone being closer together toward the vertex.

To simplify the mathematics involved in dealing with this curve, it is convenient so to locate the curve with respect to the origin that  $\theta = 0$  when  $y = 0$  and  $r = 1$ . Under these conditions,

$$b = \cos \alpha$$

$$c = \sin \alpha$$

where

$$\alpha = \frac{1}{2} \text{ included angle between opposite elements of cone.}$$

Also

$$a = \sin \alpha \cot \beta, \text{ where } \beta < 90^\circ,$$

= the constant angle with which the curve intersects the elements of the cone.

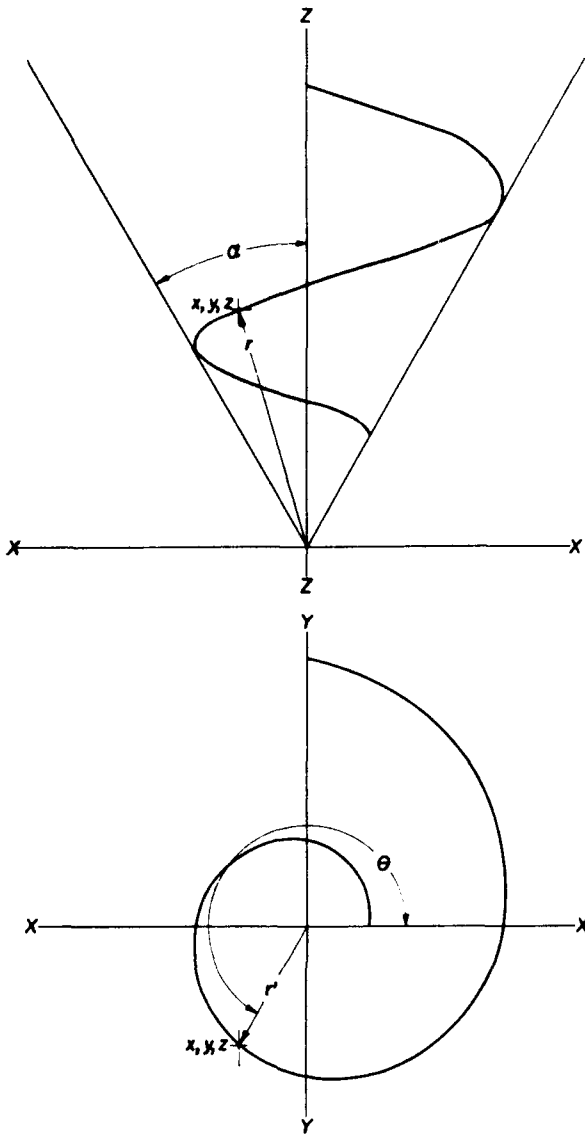


FIGURE 8.2.—The conical helix.

Thus

$$\left. \begin{aligned} x &= \sin \alpha \cos \theta e^{\theta \sin \alpha \cot \beta} \\ y &= \sin \alpha \sin \theta e^{\theta \sin \alpha \cot \beta} \\ z &= \cos \alpha e^{\theta \sin \alpha \cot \beta} \end{aligned} \right\} \quad (11)$$

$$r = e^{\theta \sin \alpha \cot \beta} \quad (12)$$

when

$r > 1$ ,  $\theta$  is plus, and when  $r < 1$ ,  $\theta$  is minus.

The expression for  $r$ , equation (12), completely represents the curve in polar coordinates, a third coordinate being unnecessary because the radius vector makes a constant angle  $\alpha$  with the  $z$  axis.

If, instead of  $\beta$ , the angle  $\gamma$  which the curve makes with the  $xy$ -plane is given,  $\cot \beta = \sec \alpha \tan \gamma$ , and the above exponent  $\theta \sin \alpha \cot \beta$  is replaced by  $\theta \tan \alpha \tan \gamma$ .

The lead angle  $s(=\gamma)$ , is accordingly given by

$$\begin{aligned} \tan s &= \cos \alpha \cot \beta \\ &= a \cot \alpha \end{aligned}$$

The projection  $r'$  of the radius vector,  $r$ , on the  $xy$ -plane is given by

$$r' = \sin \alpha e^{\theta \sin \alpha \cot \beta}. \quad (13)$$

This is a logarithmic spiral, and the equation represents the projection of the conical helix on the  $xy$ -plane.

The developed conical helix is a logarithmic spiral, derived from the parametric equations of the curve, which is represented by

$$\rho = e^{\phi \cot \beta} \quad (14)$$

where

$$\rho = \text{radius vector} = z \sec \alpha$$

$$= \cos \alpha e^{\theta \sin \alpha \cot \beta} \sec \alpha$$

$$\phi = \text{vectorial angle} = \theta \sin \alpha.$$

The length,  $S_a$ , of the arc of a conical helix subtended by the vectorial angle,  $\theta_2 - \theta_1$ , is:

$$S_a = \sin \alpha \csc \beta e^{\theta_1 \sin \alpha \cot \beta} (\theta_2 - \theta_1) \quad (15)$$

#### 4. GEOMETRICAL PROPERTIES OF TAPER SCREW THREADS

Taper screw threads are generally produced commercially with the bisector of the thread angle perpendicular to the axis of the thread. The pitch,  $p$ , is the distance, measured parallel to the axis of the thread, between any two corresponding points in an axial plane on parallel sides of adjacent threads. If  $p_c$  is the length of the line joining the two points, then,

$$p = p_c \cos y \quad (16)$$

where

$$y = \text{half-angle of taper.}$$

The same is true of any taper thread, the sides of which are unsymmetrical with respect to a line which is perpendicular to the axis and passes through a vertex of the thread.

The lead or pitch of the generatrix of the helicoid forming the side of a taper thread differs from the lead or pitch of the thread [3, 4]. The lead of the generatrix of the following side of the thread is (see fig. 8.3):

$$L_f = (p + n) = L(1 + \tan \alpha_1 \tan y). \quad (17)$$

The lead of the generatrix of the leading side of the thread is:

$$L_c = (p - m) = L(1 - \tan \alpha_2 \tan y) \quad (18)$$

where

$$L = \text{lead of thread}$$

$$\alpha_1 = \text{angle between line perpendicular to axis of thread and the following side of thread}$$

$$\alpha_2 = \text{angle between line perpendicular to axis of thread and the leading side of thread.}$$

For a symmetrical thread,  $\alpha_1 = \alpha_2 = \alpha$ , and

$$L_f = L(1 + \tan y \tan \alpha) \quad (19)$$

$$L_c = L(1 - \tan y \tan \alpha). \quad (20)$$

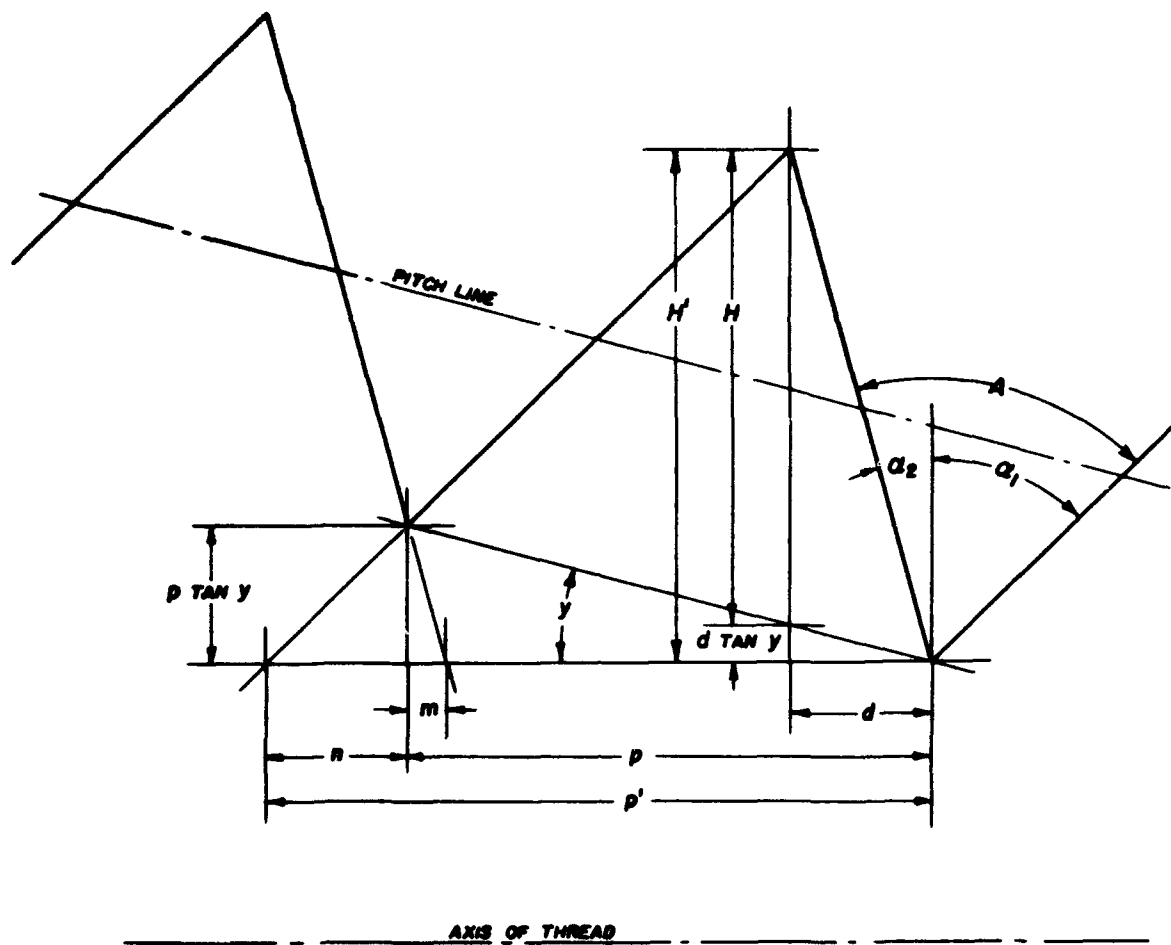


FIGURE 8.3.—Geometry of unsymmetrical taper screw thread.

The depth,  $H$ , of an unsymmetrical sharp-V taper thread is the distance, perpendicular to the axis, between the cones enveloping the thread at crest and root, and is given by the relation:

$$H = p \sec^2 y \csc A \cos (\alpha_2 + y) \cos (\alpha_1 - y) \quad (21)$$

where

$$A = \alpha_1 + \alpha_2$$

If a thread is symmetrical about the perpendicular to the axis,

$$\alpha_1 = \alpha_2 = \alpha,$$

and

$$H = \frac{p}{2} (\cot \alpha - \tan^2 y \tan \alpha). \quad (22)$$

In a taper screw thread the crest of a thread is not exactly opposite the root of the thread at points located  $180^\circ$  apart, as in a straight thread, but there is an axial displacement between these positions. This displacement is given by the formula:

$$\delta = \frac{L}{2} (1 - 2 \sec y \csc A \cos (\alpha_1 - y) \sin \alpha_2) \quad (23)$$

for an unsymmetrical thread. For a symmetrical thread this formula reduces to [3]:

$$\delta = \frac{L}{2} \tan \alpha \tan y. \quad (24)$$

For an unsymmetrical thread having the bisector of the thread angle perpendicular to the element of the cone [3],

$$\delta = \frac{L}{2} \cot \alpha \tan y. \quad (25)$$

#### 5. DIAMETER OF AN ARCHIMEDES' SPIRAL AS MEASURED BETWEEN FLAT, PARALLEL SURFACES

As previously stated, the projection of the pitch line of a taper thread gage on a plane perpendicular to the axis of the gage is an Archimedes' spiral. If parallel lines are drawn tangent to opposite sides of a segment of such a spiral, figure 8.4, the radii vectores to the points of contact subtend an angle of slightly more than  $180^\circ$ , and the distance between the lines is slightly greater than the length of the line, intercepted by the spiral, which is drawn perpendicular to these tangents through the axis of the spiral. In measuring the diameter of a taper thread gage between flat parallel anvils  $AA$  and  $BB$ , figure 8.4, the measurement obtained corresponds to the distance between the parallel lines, whereas the true diameter corresponds to the length of the intercepted perpendicular line. For commercial taper screw threads the difference,  $\Delta M$ , between these lengths is given very nearly by the formula:

$$\Delta M = E (\cos \phi - 1) + \frac{L}{\pi} \phi \tan \alpha \cos \phi \quad (26)$$

where

$E$  = true diameter, or length of intercepted line

$\theta$  = approximate mean vectorial angle at points of measurement

$\phi = \cot^{-1} \theta$

**Example:** Solve for  $\Delta M$  for presumably the worst case encountered in commercial practice, namely the A.P.I. standard 2% in. rotary joint thread.

$$L = 0.20 \text{ in.}$$

$$E = 2.36537 \text{ in.}$$

$$\text{taper} = 0.25 \text{ in./in.}$$

$$\theta = \frac{2.36537}{0.25 \times 0.20} \times 2\pi + \pi$$

$$= 300.38276 \text{ radians}$$

$$\cot \phi = \theta = 300.38276$$

$$\phi = 0^\circ 11' 28''$$

$$= 0.00334 \text{ radians}$$

$$\Delta M = 2.36537 (0.9999944 - 1) + \frac{0.20}{\pi} \times 0.125 \times 0.00334 \times 0.9999944$$

$$= +0.000013 \text{ in.}$$

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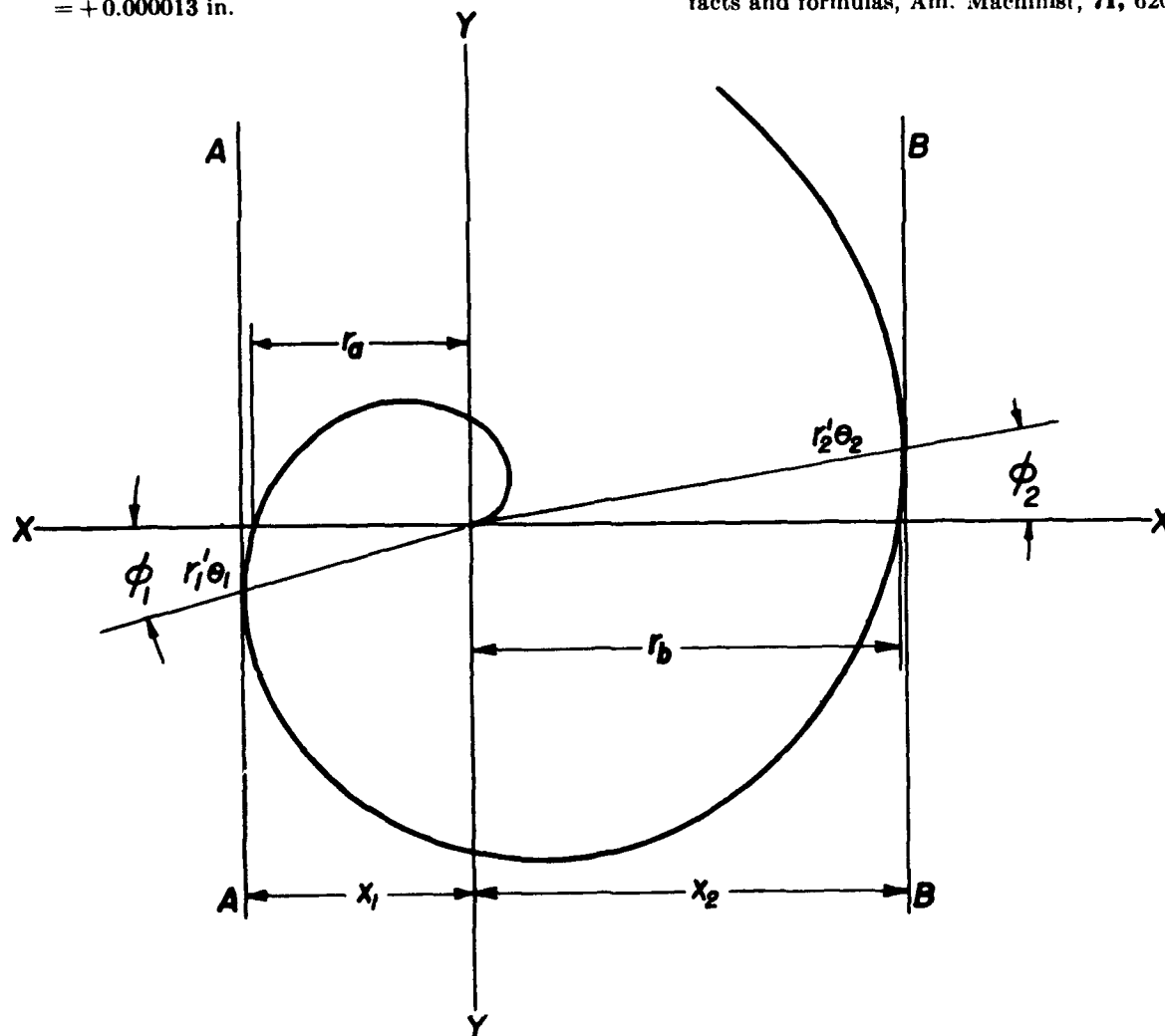


FIGURE 8.4.—Measurement of Archimedes' spiral.

## APPENDIX 9. EXTENT OF USAGE OF THE AMERICAN NATIONAL FIRE-HOSE COUPLING THREADS ON COUPLINGS AND NIPPLES USED WITH 2½ INCH NOMINAL SIZE FIRE HOSE

Listed below are the cities in the United States which had a population of 25,000 or more according to the 1950 census, and which have not standardized on the American National fire-hose coupling thread on hydrants, couplings, and nipples used with 2½ in. nominal size fire hose. The outside diameter of the nipple (external) thread is 3½ in. and the pitch is 7½ threads per inch for this American National thread. If all cities of 25,000 population or over in a state have adopted the American National standard for the 2½ in. fire hose, that state is shown in the tabulation as being 100 percent Standard.

The tabulation shows the outside diameter of the nipple (external) thread in inches and the number of threads per inch, the number preceding the dash being the outside diameter and the number following being the pitch. (Outside diameters are given to the nearest ¼ in.).

Special types of snap, clutch, or other patent couplings are designated by their trade names.

In some instances, the dimensions were not available and were left blank.

\* In some instances it may appear to be feasible to make cross connections with the American National standard thread.<sup>14</sup> However, where there are differences in pitch of more than one-half a thread between the mating parts, or differences in pitch diameter in excess of ½ in., there will not be washer tight fits. Coupling parts more than ¼ in. larger in pitch diameter than the nipple will blow off when subjected to high pressures.

ALABAMA (100% Standard)

ARIZONA

Phoenix (Adapters), 2½ to 2½—6

ARKANSAS (100% Standard)

CALIFORNIA

Burbank

COLORADO

Colorado Springs, 3 & 3½—7½

Note: Colorado Springs is in the process of changing over to the National Standard.

Denver, 3½—8

Pueblo, 3½—6

CONNECTICUT

Bridgeport, 3½ & 3½—8

Norwich, 3½—7½ and National Standard

DELAWARE (100% Standard)

DISTRICT OF COLUMBIA (100% Standard)

FLORIDA

Gainesville

Key West, 2½ to 3—8

Lakeland, 3½—6

Tallahassee, 3—6

GEORGIA

Macon, 3—8

Rome, 3½—7

IDAHO (100% Standard)

ILLINOIS

Alton, 3½ and 3½—7

Aurora, 3½—7 and National Standard

Berwyn, 3—7½

Bloomington

Champaign, 3½ and 3½—8

Chicago, 3½—7½

Cicero, 3½ to 3½—7½

Danville, 3½—8

Decatur, 3½—7

East St. Louis, 3½ & 3½—6

Elgin, 3½—7

Galesburg, 3½—7

Granite City, 3½—6

Joliet, 3—8

Kankakee, 2½ to 3—7½

Maywood, 3—7½

Moline, 3½—7

<sup>14</sup> See footnote 10, p. 91.

ILLINOIS—Continued

Oak Park, 3½—7

Peoria, 3½—7

Rock Island, 3½ & 3½—7

Springfield, 3½—7

Waukegan, 3½—7

INDIANA

Bloomington

Marion, 3½—6

IOWA

Burlington, 3½—6

Cedar Rapids, 3½—6

Clinton

Council Bluffs, 3½—8

Fort Dodge, 3½—6

Sioux City, 3½—6

KANSAS (100% Standard)

KENTUCKY

Covington, 3½ & 3½—6

Louisville, 3½—6

Newport

Paducah, 3½—6

LOUISIANA

Alexandria, 3½—8

Baton Rouge, 3½—8

Lafayette, 3½—8

Lake Charles, 3½—8

Monroe, 3½—8

New Orleans

Hose, 3½—7½

Hydrants, 3½—6

MAINE (100% Standard)

MARYLAND

Hagerstown

Hose, 3½—6

Hydrants, 3½—7

MASSACHUSETTS (100% Standard)

MICHIGAN

Dearborn, 3½—7½

Detroit, 3½—7½

Ferndale, 3½—7½

Hamtramck, 3½—7½

Highland Park, 3½—7½

Lincoln Park, 3½—7

Muskegon, 3½—6

Pontiac, 3½—7½

Royal Oak, 3½—9

Wyandotte, 3½—7½

MINNESOTA (100% Standard)

MISSISSIPPI

Biloxi

Greenville

Laurel, Iron pipe threads—8

Meridian, 3½—8 and National Standard

MISSOURI

Joplin, "Anderson" & 3½—6

St. Joseph, 3½—6

MONTANA (100% Standard)

NEBRASKA

Lincoln, 3½—8 and National Standard

Omaha, 3½—8

NEVADA (100% Standard)

NEW HAMPSHIRE (100% Standard)

NEW JERSEY

Bayonne, 3—8

Belleville, 3—8

Bloomfield, 2½ to 3—8

Camden

Hose, "Jones"

Hydrants, 3½—6

Clifton, 3—8

East Orange, 3—8

Elizabeth, 3—8

Garfield

Hoboken, 3—8

Irvington, 3 & 3½—8

Jersey City, 3—8

Kearny, 3—8

# NEW JERSEY—Continued

Linden,  $3\frac{1}{2}$ —8  
 Montclair, 3—8  
 Newark, 3—8  
 Orange  
 Passaic,  $3\frac{1}{4}$ —8  
 Paterson, 3—8  
 Plainfield, 3—8  
 West Orange, 3—8

# NEW MEXICO

Roswell  
 Santa Fe,  $3\frac{1}{4}$ —6

# NEW YORK

Amsterdam,  $3\frac{1}{2}$  &  $3\frac{1}{4}$ —6  
 Auburn,  $3\frac{1}{2}$ — $7\frac{1}{2}$  and National Standard  
 Buffalo,  $3\frac{1}{4}$ —8  
 Elmira,  $3\frac{1}{2}$ —8  
 Hempstead,  $3\frac{1}{2}$ —8  
 Ithaca,  $3\frac{1}{4}$ — $7\frac{1}{2}$   
 Jamestown,  $3\frac{1}{4}$ —8  
 Lockport,  $3\frac{1}{4}$ —8  
 Mount Vernon, 3—8  
 New Rochelle,  $3\frac{1}{2}$ —8  
 New York City,  $3\frac{1}{2}$ —8  
 Rochester,  $3\frac{1}{2}$ —7  
 Rome,  $3\frac{1}{4}$ —8  
 Schenectady, Dbl.  $3\frac{1}{8}$ —6  
 Syracuse,  $3\frac{1}{4}$ —8  
 Utica,  $3\frac{1}{4}$ —8  
 Valley Stream,  $3\frac{1}{2}$ —6  
 Yonkers, Adapters & 3—8

# NORTH CAROLINA

Asheville,  $3\frac{1}{4}$ —6  
 Raleigh,  $3\frac{1}{4}$ —6  
 Wilmington,  $3\frac{1}{4}$ —6  
 Winston-Salem,  $2\frac{5}{8}$  &  $2\frac{3}{4}$ — $7\frac{1}{2}$

# NORTH DAKOTA (100% Standard)

# OHIO

Akron,  $3\frac{1}{4}$ —6  
 Alliance,  $3\frac{1}{4}$ —6  
 Barberton,  $3\frac{1}{4}$ —6  
 Cincinnati  
 Cleveland,  $3\frac{1}{4}$ —8  
 Cleveland Heights,  $3\frac{1}{4}$ —8  
 Cuyahoga Falls,  $3\frac{1}{4}$ —6  
 Dayton,  $3\frac{1}{4}$ —6  
 East Cleveland,  $3\frac{1}{4}$ —8  
 Euclid  
 Hamilton,  $3\frac{1}{4}$ —7  
 Lakewood,  $3\frac{1}{4}$ —8  
 Middletown,  $3\frac{1}{4}$ —6  
 Parma,  $3\frac{1}{4}$ —8  
 Shaker Heights  
 Springfield,  $3\frac{1}{4}$ —6  
 Steubenville,  $3\frac{1}{4}$ —6  
 Toledo, 3 &  $3\frac{1}{4}$ —8

# OKLAHOMA

Muskogee  
 Oklahoma City,  $3\frac{1}{2}$ —6  
 Okmulgee

# OREGON (100% Standard)

# PENNSYLVANIA

Aliquippa, 3—8  
 Allentown,  $3\frac{1}{4}$ —6 & 3—8  
 Altoona,  $3\frac{1}{4}$ —6  
 Bethlehem,  $3\frac{1}{4}$ —6  
 Chester, "Jones" &  $2\frac{1}{4}$  &  $2\frac{1}{4}$ — $7\frac{1}{2}$   
 Easton, 3 &  $3\frac{1}{2}$ —6  
 Erie  
 Harrisburg,  $3\frac{1}{2}$ —8  
 Hazelton,  $3\frac{1}{2}$ —6  
 Johnstown,  $3\frac{1}{4}$ —7  
 Lancaster,  $3\frac{1}{4}$ —7  
 Lebanon, 3—8  
 McKeesport,  $3\frac{1}{2}$ —6  
 New Kensington  
 Norristown, "Jones Snap"  
 Philadelphia, "Jones Snap"  
 Pittsburgh,  $3\frac{1}{4}$ —6  
 Reading,  $3\frac{1}{2}$ —6  
 Scranton  
 Sharon  
 Washington,  $3\frac{1}{4}$ —6  
 Wilkes-Barre,  $3\frac{1}{4}$ —6  
 Wilkinsburg,  $3\frac{1}{4}$ —6  
 Williamsport,  $3\frac{1}{4}$ —6  
 York,  $3\frac{1}{4}$ —7

# RHODE ISLAND

Newport,  $3\frac{1}{4}$ —6

# SOUTH CAROLINA (100% Standard)

# SOUTH DAKOTA

Aberdeen,  $3\frac{1}{4}$ —6  
 Rapid City, 3—8

# TENNESSEE (100% Standard)

# TEXAS

San Angelo  
 Temple

# UTAH

Salt Lake City,  $3\frac{1}{4}$ —6

# VERMONT

Burlington,  $3\frac{1}{4}$ —6

# VIRGINIA

Charlottesville,  $3\frac{1}{4}$ —8  
 Petersburg,  $2\frac{1}{4}$ —8  
 Richmond,  $3\frac{1}{4}$ —8  
 Roanoke, "Clay Snap"

# WASHINGTON (100% Standard)

# WEST VIRGINIA

Charksburg,  $3\frac{1}{4}$ —6  
 Fairmont, 3—8  
 Huntington,  $3\frac{1}{4}$  &  $3\frac{1}{2}$ —6  
 Martinsburg,  $3\frac{1}{4}$ —6  
 Wheeling,  $3\frac{1}{4}$ —6

# WISCONSIN (100% Standard)

# WYOMING

Casper,  $3\frac{1}{4}$ —7 and National Standard  
 Cheyenne,  $3\frac{1}{4}$ —6

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