

TECHNICAL DATA

External Pipe Threads

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The information in this book applies only to external taper and straight pipe threads. It contains data in a condensed and simplified form especially computed and compiled by our company from various standards. It is arranged for the convenience of those who use the thread rolling process.

The efforts of the REED-RICO® organization are devoted exclusively to the study and development of cold forming, thread rolling and the design and manufacture of thread rolling dies, machinery, knurls, thread rolls, thread rolling attachments and other accessory equipment. We have been closely allied with the thread rolling industry for over seventy-seven years. During this long period we have had a wide and varied experience which has enabled us to assist many users with their thread rolling applications.

You are assured of our full cooperation in assisting you with problems concerning any threading requirement.

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The data used in compiling the information in this book was obtained from the standards and other material published by the following:

Air Materiel Command

Wright-Patterson Air Force Base, Dayton, OH

American Petroleum Institute

50 West 50th Street, New York, NY

American Society of Mechanical Engineers

29 West 39th Street, New York, NY

American Standards Association, Inc.

70 East 45th Street, New York, NY

Compressed Gas Manufacturers Association

11 West 42nd Street, New York, NY

Screw-Thread Standards for Federal Services

National Bureau of Standards Handbook H28

1944 and 1950 Supplement, Superintendent of Documents
US Government Printing Office, Washington, DC

Society of Automotive Engineers, Inc.

29 West 39th Street, New York, NY

General Information

Pipe threads are usually classified under two general headings.

- a. Taper Pipe Threads
- b. Straight Pipe Threads

This book is devoted to external pipe threads only. Section 2 (pages 8 to 17) covers Taper Pipe Threads, Section 3 (pages 18 to 22) Straight Pipe Threads and Section 4 (page 23) Blank Diameters.

Each pipe thread series has its own identification symbol which is composed from the following letters:

- AN = Aeronautical National Form
- Cl = Chlorine Gas
- F = Fuel and Oil (Dryseal)
- G = Grease or Gases (except Chlorine)
- H = Hose Coupling
- I = Intermediate Internal (Dryseal)
- L = Locknut
- M = Mechanical
- N = National or American
- P = Pipe
- R = Railing Fittings
- S = Straight
- T = Taper

The tabulation on page 5 gives a brief description of the commonly used taper and straight pipe threads. Three symbols (shown with *) for internal threads only are included in the tabulation for informative purposes. Detailed information pertaining to these threads is given in Sections 2 and 3, and the page number references for this information are shown in the table.

For those who wish more detailed information than is given in this book, references are made to the American Standards Association pamphlets, the Screw-Thread Standards for Federal Service Handbook H28 (1944) and the 1950 Supplement and sources noted in the footnote below the table. These standards may be procured from the addresses shown below the Contents on page 3.

Pipe Threads for Electrical Conduit

The external pipe threads on electrical conduit may be either taper or straight. The taper external threads are usually made in accordance with the specifications for the American Standard Taper Pipe Threads (NPT) with the exception that some conduits in the smaller sizes, up to 1", may be threaded at the mill with a taper of 1/32" per inch in place of the standard taper of 1/16" per inch. The straight external threads are the same as the American Standard Thread Straight Pipe Threads (NPSM)

for free-fitting mechanical joints. The pitch diameters of the internal threads are greater than those used for fittings required to make pressure type joints.

The straight external running threads for conduits as used for fixture stems and conduit fittings are made in accordance with the dimensions for American Straight Pipe Threads (NPSM) for free-fitting mechanical joints.

NGO-National Gas Outlet Threads

American National Gas Outlet threads symbol NGO, have been standardized by the Compressed Gas Manufacturers Association. These are straight machine screw type of threads and not pipe threads. All have 14 threads per inch and are the American Standard form of thread on special external and internal diameters. Both right hand and left hand threads are used and designations RH or LH (right hand or left hand) and EXT or INT (external or internal) are required in the specifications of these threads. An allowance of .005" is provided between the mating threads.

The designation NGO (Cl) applies to the alternate thread for chlorine gas.

Connections for Compressed Gas Cylinders

While the practice for all of these threads is fairly well established, only the NGO outlet threads have been fully standardized.

Some outlet connections have taper pipe threads, but these threads are designated as NPT threads and are made to the American Standard Taper Pipe Thread specifications. There are various other threads used for the neck or valve to cylinder connection, the safety device cap or plug, and the threads associated with the valve mechanism.

The threads on the inlet or valve to cylinder connection are usually designated as:

- NGIT = National Gas Inlet Taper Thread
- SGIT = Special Gas Inlet Taper Thread
- NGIS = National Gas Inlet Straight Thread

Complete information pertaining to these threads is given in American Standard Association B57.1.

The specifications contained in this book do not cover any of these threads, except those used for the neck or valve to cylinder connections (NPTG and NPTC) and any others that may conform to one of the standard pipe threads.

Pipe Thread Symbols

Thread Symbol	Type Thread		Description of Thread	Refer to Page No.	ASA Standards No. (Refer to latest issue)	H28 Handbook (1944 or 1950 Supplement) Section No.
	Straight	Taper				
ANPT		x	Aeronautical National Taper Pipe Thread	8	(**)	(**)
NGIS	x		National Gas Inlet Straight Thread	4	B57.1	---
NGIT		x	National Gas Inlet Taper Thread	4	B57.1	---
NGO	x		American National Gas Outlet Thread (not used for chlorine gas)	4	B57.1	VIII
NGO(C1)	x		American National Gas Outlet Thread, (alternate thread for chlorine gas)	4	B57.1	VIII
NH	x		American Standard Hose Coupling Thread, ½" - 1½" diameters, for garden hose, chemical engine and booster hose, and fire protection hose couplings and nipples.	18	---	VI
NH	x		American Standard Fire Hose Coupling Thread, 2½" - 4½" diameters, for fire hose couplings and nipples	18	---	VI
*NPSC	x		American Standard Straight Pipe Thread (internal) in couplings for use with NPT taper <u>external</u> thread	19	B 2.1	VI
*NPSI	x		American Standard Internal Straight Pipe Thread (Dryseal) for use with NPTF taper external thread	19	B 2.1	VI
NPSH	x		American Standard Hose Coupling Thread, ½" - 2" diameters for steam, water, air, oil and all hose couplings and nipples other than NH.	18	B 2.1	VI
*NPSF	x		American Standard Intermediate Internal Straight Pipe Thread (Dryseal) for use with PTF-SAE Short or NPTF taper external thread.	19	B 2.1	---
NPSL	x		American Standard Straight Pipe Thread for loose fitting mechanical joints with locknuts.	18	B 2.1	VI
NPSM	x		American Standard Straight Pipe Thread for free fitting mechanical joints.	18	B 2.1	VI
NPT		x	American Standard Taper Pipe Thread	8	B 2.1	VI
NPTC		x	American Standard Taper Pipe Thread for chlorine gas discharge valve connections.	8	B 2.1	---
NPTF		x	American Standard Taper Pipe Thread (Dryseal)	8	B 2.1	VI
NPTG		x	American Standard Taper Pipe Thread for connection of discharge valves to compressed gas cylinders (except chlorine).	8	B 2.1	---
NPTR		x	American Standard Taper Pipe Thread for railing fittings.	8	B 2.1	VI
PTF-SAE Short	x		Society of Automotive Engineers Short Taper Pipe Thread (Dryseal).	8	(***)	(***)
SGIT		x	Special Gas Inlet Taper Thread	4	B57.1	---

* These symbols are used for internal threads only and are shown for informative purposes.

** Not an American Standard - refer to Military Specification - Mil-P-7105 (supersedes Army Navy Aeronautical Specification AN-P-363).

*** Not an American Standard - refer to Society of Automotive Engineers Handbook.

Pipe Sizes and Threads per inch

for Commonly Used Taper and Straight Pipe Thread Series

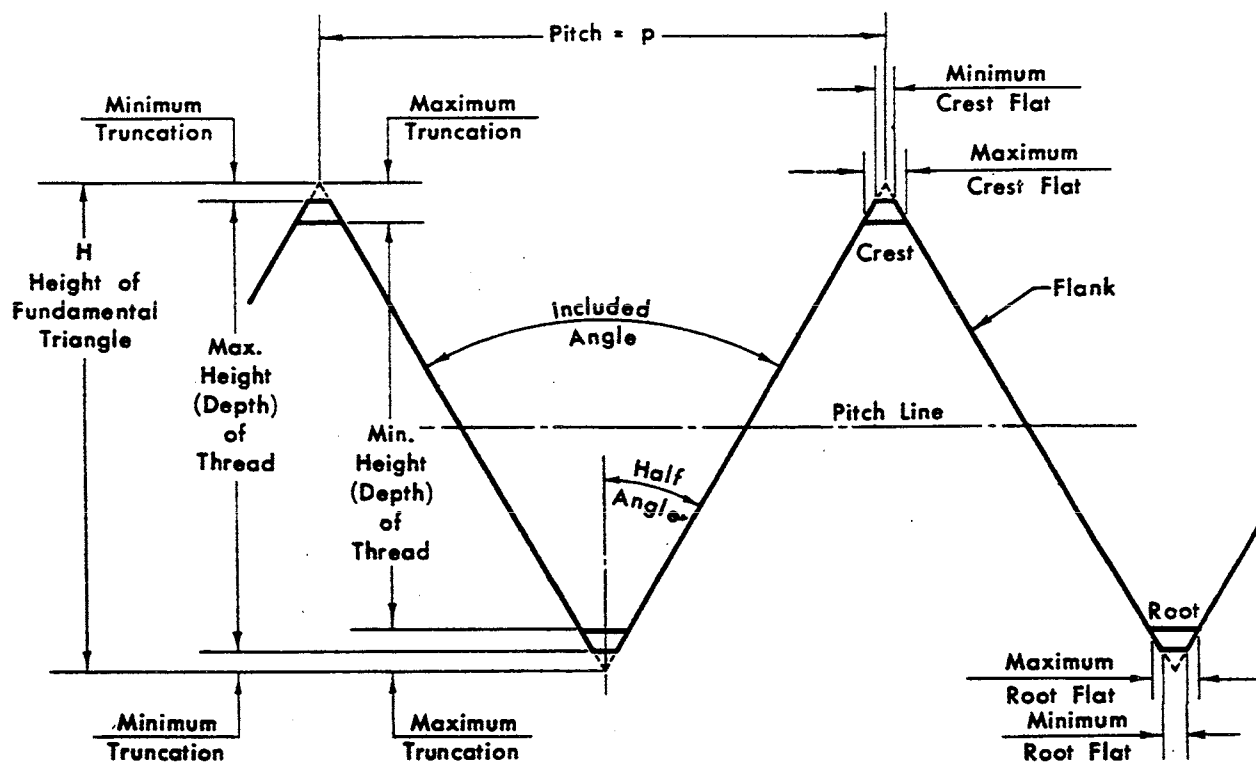
For thread specifications refer to Tables of Thread form, diameter and lengths.

Nom- inal Pipe Size	TAPER THREADS						STRAIGHT THREADS						
	NPT Amer. Std.	ANPT Aero- nauti- cal	NPTF Dry- seal	NPTF Railing Fittings	NPTG Misc. Gas	NPTC Chlo- rine Gas	NPSM Mech. Joints	NPSL Lock- nut Connec.	NPSH * Misc. Hose	NH			
										Garden Hose	Chem Engine and Booster Hose	Fire Protec- tion Hose	Fire Hose
1/16	27	27	27										
1/8	27	27	27				27	27					
1/4	18	18	18				18	18					
3/8	18	18	18				18	18					
1/2	14	14	14	14	14		14	14	14	11½			
5/8										11½			
3/4	14	14	14	14	14	14	14	14	14	11½	8		
1	11½	11½	11½	11½	11½		11½	11½	11½		8		
1¼	11½	11½	11½	11½			11½	11½	11½				
1½	11½	11½	11½	11½			11½	11½	11½			9	
2	11½	11½	11½	11½			11½	11½	11½				
2½	8	8	8	8			8	8					7½
3	8	8	8	8			8	8					6
3½	8			8			8	8					6
4	8			8			8	8					
4½													4
5	8						8	8					
6	8						8	8					
8	8							8					
10	8							8					
12	8							8					
14 OD	8												
16 OD	8												
18 OD	8												
20 OD	8												
24 OD	8												

* For steam, water, air, oil and all other hose connections not covered by the NH threads.

General Terms

Applied to External Pipe Threads



Basic Form of Thread

The basic form of a thread is the theoretical profile of the thread for a length of one pitch, in a plane parallel to the axis, on which the design forms of the threads for both the external and internal threads are based. The basic form has a 60° included angle.

Fundamental Triangle

the fundamental triangle is the triangle whose points coincide with three consecutive intersections determined by the extended flanks of the basic form. The height of the fundamental triangle of a thread is measured perpendicular to the axis.

$$\text{Height of Fundamental Triangle (for sharp V thread)} = H = .86603 \times \text{pitch}$$

Pitch

The pitch of a thread is the distance, measured parallel to its axis, between corresponding points on adjacent thread forms.

$$\text{Pitch} = \frac{1}{\text{number of threads per inch}}$$

Threads Per Inch

The number of threads per inch is the reciprocal of the

pitch (1/pitch) in inches. Threads per inch may be expressed as either n or TPI.

Basic Size

The basic size of a dimension is the theoretical size from which the limits of size for that dimension are derived by the application of the allowance and tolerances.

Nominal Size

The nominal size is the designation which is used for the purpose of general identification.

Limits of Size

These limits are the maximum and minimum sizes permissible for a specific dimension.

Tolerance

The tolerance on a dimension is the total permissible variation in its size. The tolerance is the difference between the limits of size.

Allowance

An allowance is an intentional difference in correlated dimensions of mating parts. It is the minimum clearance (positive allowance) or maximum interference (negative allowance) between such parts.

Taper Pipe Threads

General Information

In this section is given a general description of the most common types of taper threads used, formulas and terms applied, and specifications of thread form, diameters and lengths. The relationship of chamfers to the measuring of the pitch diameter is also illustrated.

Many of the common types of pipe connections employ an external taper and an internal taper thread. However, external taper pipe threads are sometimes used with internal pipe threads.

Types of Taper Pipe Threads

NPT - American Standard Taper Pipe Thread, for use with lubricant or sealer.

ANPT - Aeronautical National Taper Pipe Thread, Military Specification - Mil-P-7105 (supersedes AN-P-363), for use on aeronautical parts. Used with lubricant or sealer when assembly requires pressure type joints.

NPTF - American Standard Taper Pipe Thread (Dryseal) for pressure tight joints. Used without lubricant or sealer.

PTF-SAE Short - Society of Automotive Engineers Short External or Internal (as specified) Taper Pipe Thread (Dryseal). The external thread is primarily for assembly with NPSI (Dryseal) straight internal, but may be used with NPTF (Dryseal) taper internal threads. The external thread is not designed for assembly with PTF-SAE Short Internal Thread.

The external thread is used without lubricant or sealer and is the same as the NPTF External Thread except that the thread length is made shorter by removing one thread from the small end.

Since some users specify dryseal threads shorter than PTF-SAE short, it is desirable to always obtain complete information about this type of thread rather than depend on the identification symbol.

NPTR - American Standard Taper Pipe Thread for railing fittings. Thread length is less than NPT.

NPTG - American Standard Taper Pipe Thread for the connection of discharge valves to compressed gas cylinders. It is not used for chlorine gases. Thread length is greater than NPT.

NPTC - American Standard Taper Pipe Thread for Chlorine Gas discharge valve connections. These threads are made in 3/4"-14 basic size and three oversize diameters. The thread is similar to NPTG and the length is greater than NPT. Dash numbers following the symbol indicate thread diameters. -1 has same small end diameter as NPTG while -2, -3 and -4 have oversize diameters.

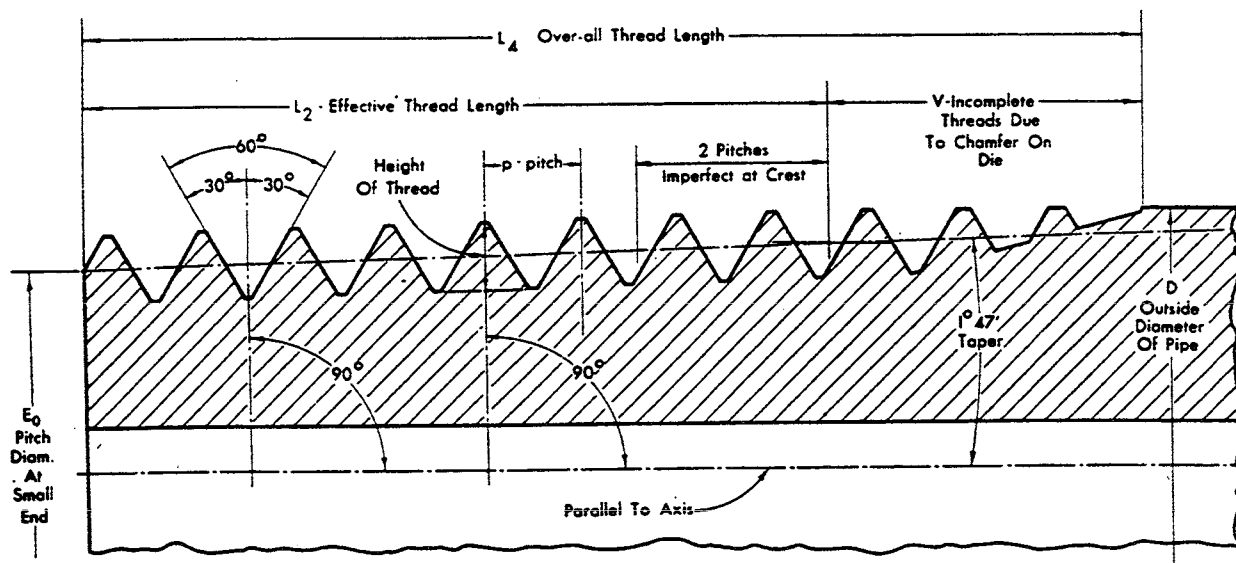
American Petroleum Institute Standards (API)

Pipe threads produced for the oil industry have been standardized by the American Petroleum Institute. The dimensions for these threads are covered by API specifications for material and equipment. The threads for API Standard Line Pipe are interchangeable with the American Standard Taper Pipe Thread (NPT) except for the 2 inch nominal size which has a longer thread length than the NPT thread, and the 15" diameter and 17" diameter sizes which are not included in the American Standard (NPT) threads.

It is always advisable to refer to the API specifications for complete information, as the API specifications also list other products which are not threaded in agreement with the American Standard for Pipe Threads. Threads produced in accordance with the API specifications are designated by the marking "API". License is required to use the API marking on products made to the API specifications.

Terms and Formulas

Taper Pipe Threads



Taper of Thread

The taper of the thread is 1/16" per inch or 3/4" per foot measured on the diameter and along the axis. The half angle of the taper is equal to 1°47'.

Basic Pitch Diameter of Thread- E_0

The basic pitch diameter of an external taper thread is measured at the beginning of the thread on the end of the pipe. It is determined by the following formula based on the basic outside diameter of the pipe and the pitch of the thread:

$$E_0 = D - (0.050D + 1.1) 1/n$$

or

$$E_0 = D - (0.050D + 1.1) p$$

where:

E_0 = Basic pitch diameter at end of pipe

D = Basic outside diameter of pipe

n = Number of threads per inch

p = Pitch of thread

Effective Length of Thread- L_2

The effective length of an external taper thread is that portion of the thread which has correct root profile its entire length and excludes the incomplete threads made by the chamfer on the dies.

The length of the effective thread on pipes with cut threads usually includes two usable threads at the large end of the L_2 length which are slightly imperfect at the crest. These imperfect crests occur at the point of intersection of a cone formed by the crests of the threads and a cylinder forming the external surface of the pipe. There are usually no imperfect crests at this point on pipes when the threads are rolled.

However, imperfect crests in the effective thread length L_2 are not always permissible on fully machined fitting and bosses as covered by the ANPT and NPTF specifications.

The effective length is determined by the following formula based on the basic outside diameter of the pipe and the pitch of the thread:

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

or

$$L_2 = (0.80D + 6.8) p$$

where:

L_2 = Effective length of thread

D = Basic outside diameter of pipe

n = Number of threads per inch

p = Pitch of thread

Overall Length of Thread - L_4

The overall length of an external taper thread is the total length of thread which includes the incomplete threads made by the chamfer on the dies.

Length of Hand-Tight Engagement - L_1

The normal length of engagement between external and internal taper threads, when screwed together by hand, is designated by length L_1 . This length is controlled through the use of gages.

In special applications such as flanges for high pressure work, longer engagement is sometimes used and the pitch diameter E_0 at the end of the external thread is proportionally smaller. The pitch diameter at the large end of the internal thread remains the same.

Height (Depth) of Thread

The height (or depth) of thread is the difference between the radii of the major and minor cones, measured on a line perpendicular to the axis.

Crest and Root Flats

The crests and root flats may be wither parallel to the taper or parallel to the axis. The flats are measured parallel to the axis.

Crest and Root Clearance and Interference

Crest and root clearance, or interference, in a thread assembly is the distance between the crest or root of the thread and the corresponding crest or root of the mating thread. It is measured perpendicular to the axis. Maximum clearances and interferences for NPT, ANPT and NPTF threads are shown on page 14.

Complete Thread

The complete or effective thread is that part of the thread having full form at both crest and root. On external taper pipe threads there may be imperfect crests at the intersection of the major cone and the outside diameter of the pie or fitting, as mentioned under "Effective Length of thread" on page 9. Refer also to "Chamfers at End of Threads" on page 11 and note from the illustrations on pages 9, 14 and 16 that the thread lengths are measured from the E0 pitch diameter.

The incomplete thread is that portion of the thread formed by the chamfer or bevel on the die and is not considered part of the complete or effective thread. This is illustrated on page 9. The total or overall thread includes the complete or effective thread and the incomplete thread.

Pitch Diameters at Different Thread Lengths

Pitch diameters usually designated by the letter E and are specified at given positions on the thread axis according to different thread lengths. The same sub numeral is used to designate the position of the pitch diameter as is used to designate the respective thread length dimensions as shown on page 15.

Formulas for Truncation and Width of Flat on Taper Pipe Threads

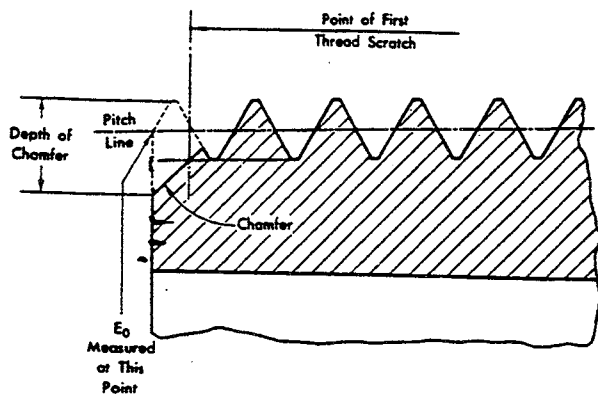
Threads per inch	Pitch P	NPT & ANPT				NPTF (DRYSEAL)							
		Truncation		Width of Flat		Truncation				Width of Flat			
		Crest or Root		Crest or Root		Crest		Root		Crest		Root	
		Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
27	.0370	.096p	.033p	.111p	.038p	.094p	.047p	.140p	.094p	.108p	.054p	.162p	.108p
18	.0556	.088p	"	.102p	"	.078p	"	.109p	.078p	.090p	"	.126p	.090p
14	.0714	.078p	"	.090p	"	.060p	.036p	.085p	.060p	.070p	.042p	.098p	.070p
11½	.0870	.073p	"	.084p	"	"	.040p	.090p	"	.069p	.046p	.103p	.069p
8	.1250	.062p	"	.072p	"	.055p	.042p	.076p	.055p	.064p	.048p	.088p	.064p

NOTE: See page 13 for Actual Dimensions of Truncation and Width of Flat.

Chamfers at End of Threads

For American Standard External Thread (NPT)

No chamfers are required on these threads; and, although they may be chamfered, no specifications are available to govern the angle and depth of chamfer to be used.



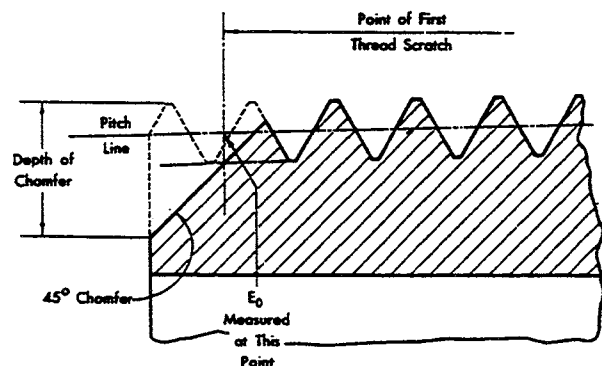
Specifications do indicate, however, that when these threads are chamfered, the pitch diameter at the small end (E₀) of the external thread should still be measured at the end of the pipe or fitting as shown.

For Aeronautical National External Thread (ANPT)

The small end of these threads are chamfered 45° by the depth given in the following table.

THREADS PER INCH	27	18	14	11-1/2	8
DEPTH OF CHAMFER	1/32"	3/64"	1/16"	5/64"	7/64"

When drawings or other data specify chamfers in excess of those shown above, the pitch diameter at the small end (E₀) is measured at the point of first thread scratch (at height of thread)-as shown.



Tolerances for Taper Pipe Threads

Pitch diameter tolerances for common types of taper pipe threads are given on page 14. Major and minor diameter tolerances are controlled by the limits of the thread forms given on page 13.

Pipe Size	T.P.I.	Taper Tolerance per inch of length (Taper is .0625 per inch) on Diameter			Lead Tolerance in Effective Thread Length (L ₂) or 1 inch of Length, whichever is shorter			Thread Angle Tolerance		
		*NPT	ANPT	NPTF	*NPT	ANPT	NPTF	60° Incl. Angle	30° Half Angle of Thread	
								*NPT	ANPT	NPTF
1/16	27	+ .0104 - .0052	± .0052	± .0026	± .003	± .002	± .001	± 2½°	± 1°	± 1°
1/8	27	"	"	"	"	"	"	"	"	"
1/4	18	"	"	"	"	"	± .0015	± 2°	"	"
3/8	18	"	"	"	"	"	"	"	"	"
1/2	14	+ .0078 - .0052	"	"	"	"	± .002	"	"	"
3/4	14	"	"	"	"	"	"	"	"	"
1	11½	"	"	"	"	"	± .0025	± 1½°	± ¾°	± ¾°
1 ¼	11½	"	"	"	"	"	"	"	"	"
1 ½	11½	"	"	"	"	"	"	"	"	"
2	11½	"	"	"	"	"	"	"	"	"
2½ and Larger	8	+ .0052 - .0026	"	"	± .006	See Note	± .004	"	"	"

NOTE: Military specifications for Aeronautical National Taper Pipe Threads (ANPT) do not limit the lead tolerance to a maximum length of 1 inch. They state that the lead tolerance, for any pipe size, shall be for any two threads within the effective thread length. On sizes up to 2 1/2" the effective thread length does not exceed 1 inch.

* Includes other American Standard Taper Pipe Threads, such as: NPTR, NPTG and NPTC.

Lead

The lead is the distance a threaded part moves axially, with respect to a fixed mating part, in one complete rotation.

Lead Angle

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

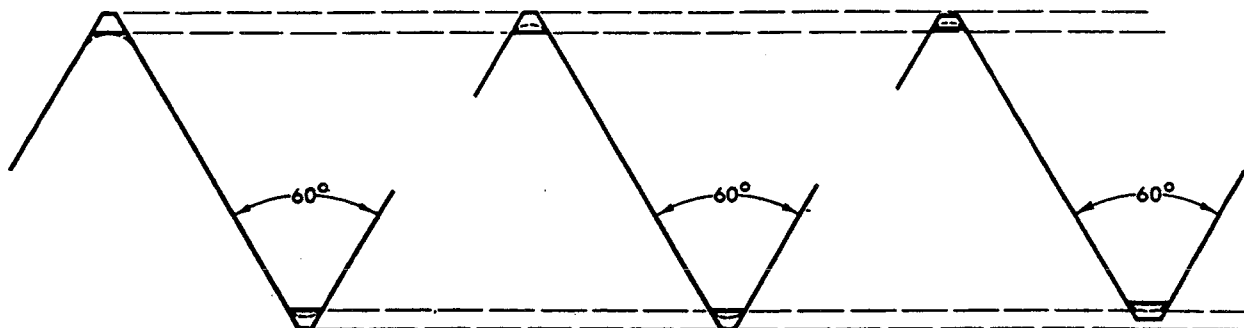
Included Angle

The included angle of a thread is the angle between the flanks of the thread measured in an axial plane.

Flank (Half) Angle

A flank angle of a symmetrical thread is commonly termed the "half-angle of thread". It is the angle between the flank of the thread and a line perpendicular to the axis of the thread and is measured in an axial plane.

Thread Form Specifications for External Taper Pipe Threads



NPT, NPTR, NPTC and NPTG
American Standard

ANPT
Aeronautical National Form

NPTF
American Standard (Dryseal)

The dotted radii show the permissible rounding due to worn tools. The radius at the crest of the NPT, NPTR, NPTC and NPTG thread may be outside of the truncation tolerance. However, the radii at the crests of the ANPT and NPTF threads and at the roots of all of these threads must be within the truncation tolerance.

SPECIFICATIONS for NPT, NPTR, NPTC or NPTG and ANPT THREADS

Threads per inch	Pitch	Height Fundamen. Triangle**	*Truncation		*Width of Flat		Height of Thread	
			Max.	Min.	Max.	Min.	Max.	Min.
27	.0370	.0321	.0036	.0012	.0041	.0014	.0296	.0250
18	.0556	.0481	.0049	.0018	.0057	.0021	.0444	.0383
14	.0714	.0619	.0056	.0024	.0064	.0027	.0571	.0507
11½	.0870	.0753	.0063	.0029	.0073	.0033	.0696	.0626
8	.1250	.1083	.0078	.0041	.0090	.0048	.1000	.0928

* Dimensions given are for both crest and root.

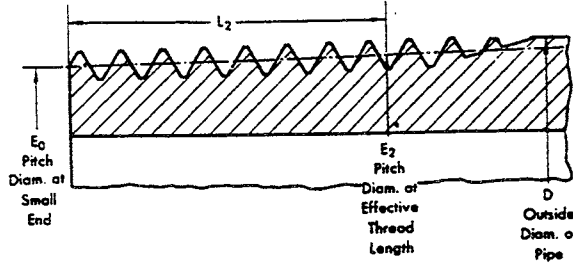
** Height of Sharp V Thread.

SPECIFICATIONS for NPTF (DRYSEAL) THREADS

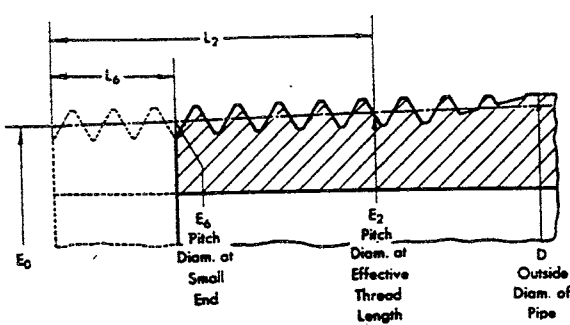
Threads per inch	Truncation				Width of Flat				Height of Thread	
	Crest		Root		Crest		Root		Max.	Min.
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.		
27	.0035	.0017	.0052	.0035	.0040	.0020	.0060	.0040	.0269	.0234
18	.0043	.0026	.0061	.0043	.0050	.0030	.0070	.0050	.0412	.0377
14	.0043	.0026	.0061	.0043	.0050	.0030	.0070	.0050	.0550	.0515
11½	.0052	.0035	.0078	.0052	.0060	.0040	.0090	.0060	.0666	.0623
8	.0069	.0052	.0095	.0069	.0080	.0060	.0110	.0080	.0962	.0919

Diameters of External Taper Pipe Threads

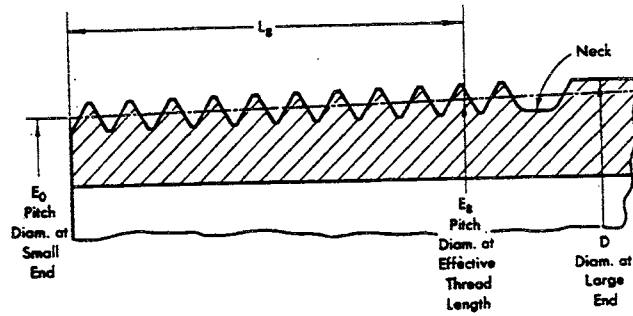
Note: NPT 5" thru 24" OD sizes are not included in tables.



NPT, ANPT and NPTF



NPTR



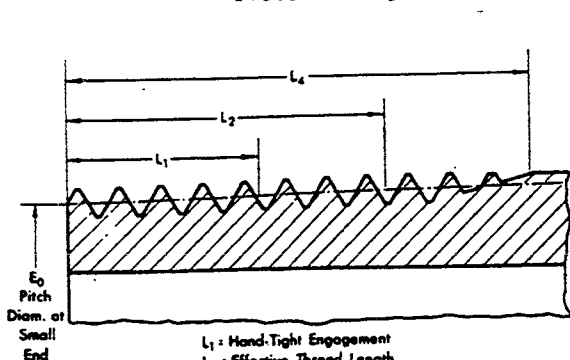
NPTG and NPTC

Pipe Size	T.P.I.	D			Pitch Diameter at Small End						Pitch Diameter at effective Thread Length		
		Out. Diam. of Pipe	Outside Diameter of Valve		E0	Tolerance		E6	Tolerance		E2	E8	
			NPTG	NPTC		Turns of Gage	Inches on Diam.		Turns of Gage	Inches on Diam.		NPT	NPTG at L1+5 Thd.
		NPT ANPT NPTR NPTF NPTC			NPT ANPT NPTR NPTF NPTC			NPTR			NPT ANPT NPTR NPTF NPTC		
1/16	27	.313			.2712		±.0023				.2875		
1/8	27	.405			.3635		"				.3800		
1/4	18	.540			.4774		±.0035				.5025		
3/8	18	.675			.6120		"				.6375		
1/2	14	.840	.863		.7584		±.0045	.7718			.7918	.8008	
3/4	14	1.050	1.081		.9677		"	.9811			1.0018	1.0112	
3/4-14NPTC-1				1.096	.9677		"						1.0268
3/4-14NPTC-2				1.114	.9856		"						1.0447
3/4-14NPTC-3				1.134	1.0057		"						1.0648
3/4-14NPTC-4				1.159	1.0302		"						1.0893
1	11½	1.315	1.346		1.2136		±.0054	1.2299			1.2563	1.2658	
1½	11½	1.660			1.5571		"	1.5734			1.6013		
1¾	11½	1.900			1.7961		"	1.8124			1.8413		
2	11½	2.375			2.2690		"	2.2853			2.3163		
2½	8	2.875			2.7195		±.0078	2.7508			2.7906		
3	8	3.500			3.3406		"	3.3719			3.4156		
*3½	8	4.000			3.8375		"	3.8688			3.9156		
*4	8	4.500			4.3344		"	4.3656			4.4156		

* Does not include ANPT, NPTF, NPTG or NPTC.

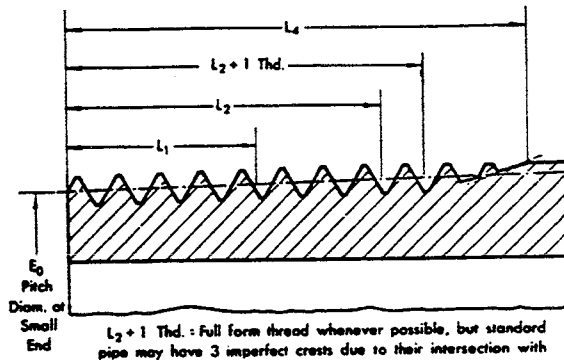
Lengths of External Taper Pipe Threads

Note: NPT 5" thru 24" OD sizes are not included in tables.



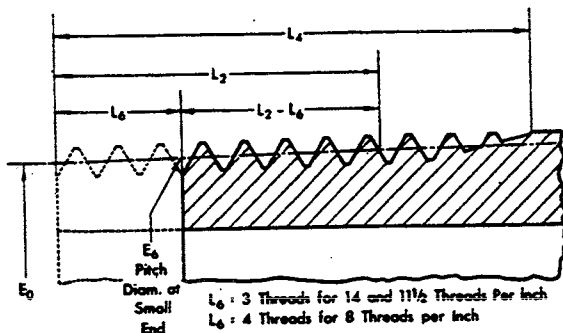
L_1 - Hand-Tight Engagement
 L_2 - Effective Thread Length
 L_4 - Over-all Thread Length

NPT



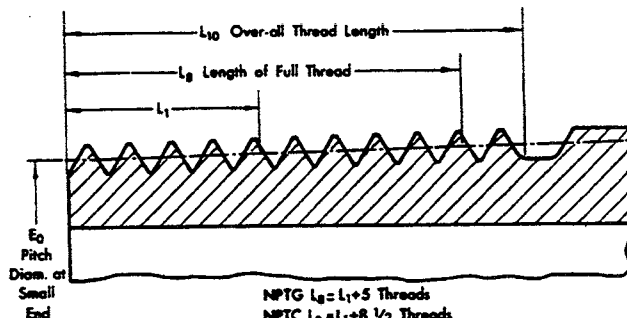
$L_2 + 1$ Thd. : Full form thread whenever possible, but standard pipe may have 3 imperfect crests due to their intersection with the outside diameter of the pipe.

ANPT and NPTF



L_6 : 3 Threads for 14 and $1\frac{1}{2}$ Threads Per inch
 L_6 : 4 Threads for 8 Threads per inch

NPTR



NPTG $L_8 = L_1 + 5$ Threads
NPTC $L_8 = L_1 + 8\frac{1}{2}$ Threads

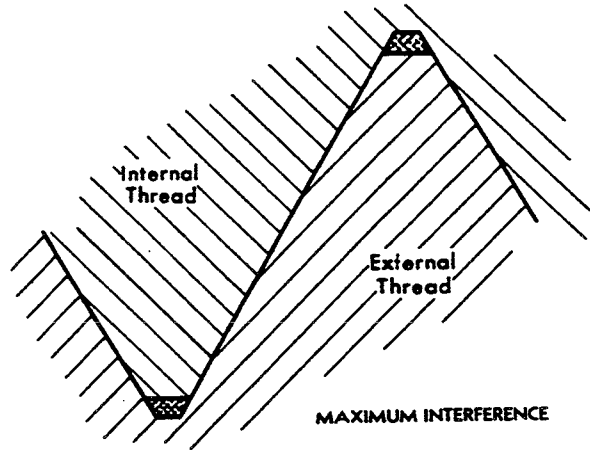
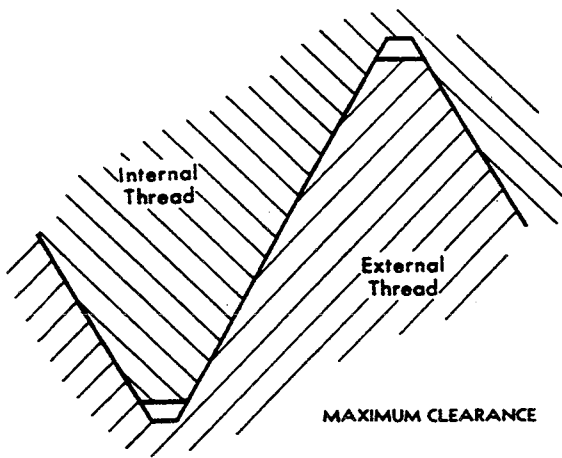
NPTG and NPTC

Pipe Size	Threads per inch	Pitch	L1 Handtight Engagement	Effective Thread Length			Over-all Thread Length		
				L2 NPT ANPT NPTF	L2-L6 NPTR	L8 NPTG NPTC	L4 NPT ANPT NPTF	L4-L6 NPTR Max.	L10 NPTG NPTC
1/16	27	.0370	.160	.2611			.3896		
1/8	27	.0370	.180	.2639			.3924		
1/4	18	.0556	.200	.4018			.5946		
3/8	18	.0556	.240	.4078			.6006		
1/2	14	.0714	.320	.5337	.320	.6771	.7815	.499	3/4
3/4	14	.0714	.339	.5457	.332	.6961	.7935	.510	7/8
3/4-14 NPTC-1		.0714	.339			.9461			1-1/8
3/4-14 NPTC-2		.0714	.339			.9461			1-1/8
3/4-14 NPTC-3		.0714	.339			.9461			1-1/8
3/4-14 NPTC-4		.0714	.339			.9461			1-1/8
1	11 1/2	.0870	.400	.6828	.422	.8348	.9845	.639	1
1 1/4	11 1/2	.0870	.420	.7068	.446		1.0085	.707	
1 1/2	11 1/2	.0870	.420	.7235	.463		1.0252	.724	
2	11 1/2	.0870	.436	.7565	.496		1.0582	.757	
2 1/2	8	.1250	.682	1.1375	.638		1.5712	1.013	
3	8	.1250	.766	1.2000	.700		1.6337	1.075	
*3 1/2	8	.1250	.821	1.2500	.750		1.6837	1.125	
*4	8	.1250	.844	1.3000	.800		1.7337	1.175	

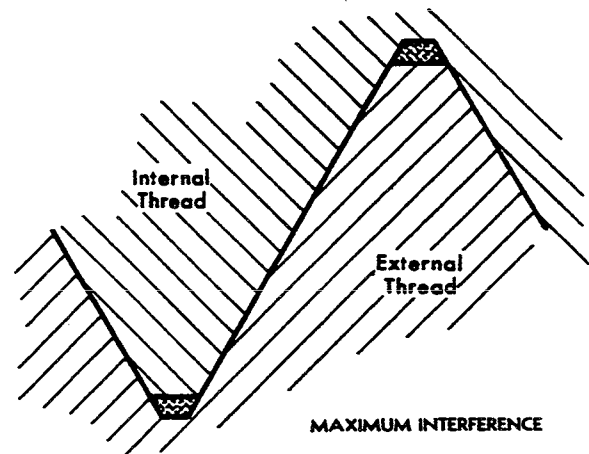
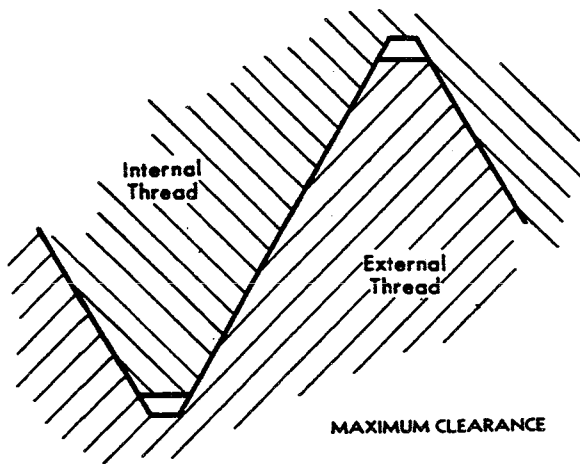
* Does not include ANPT, NPTF, NPTG or NPTC.

Clearances and Interferences of Crests and Roots

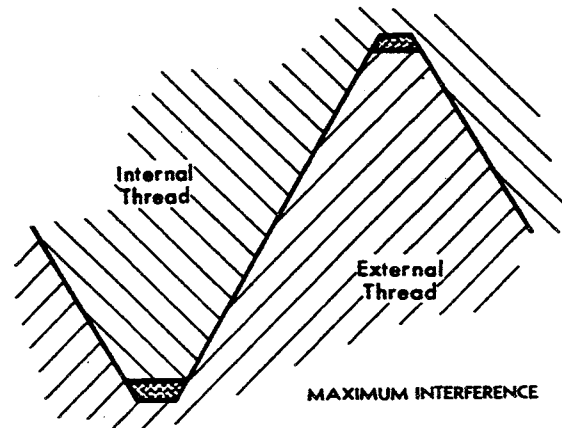
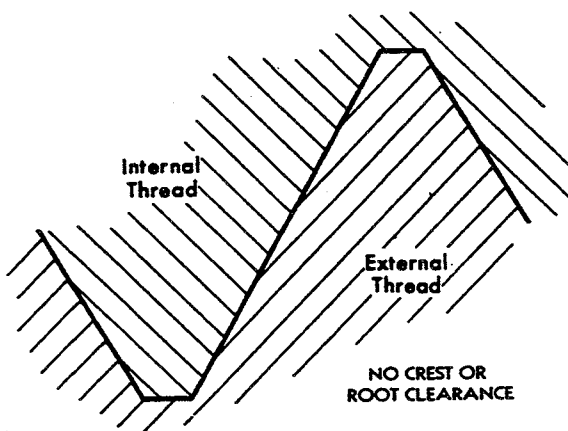
External and Internal Taper Pipe Threads—NPT, ANPT and NPTF



NPT-AMERICAN STANDARD



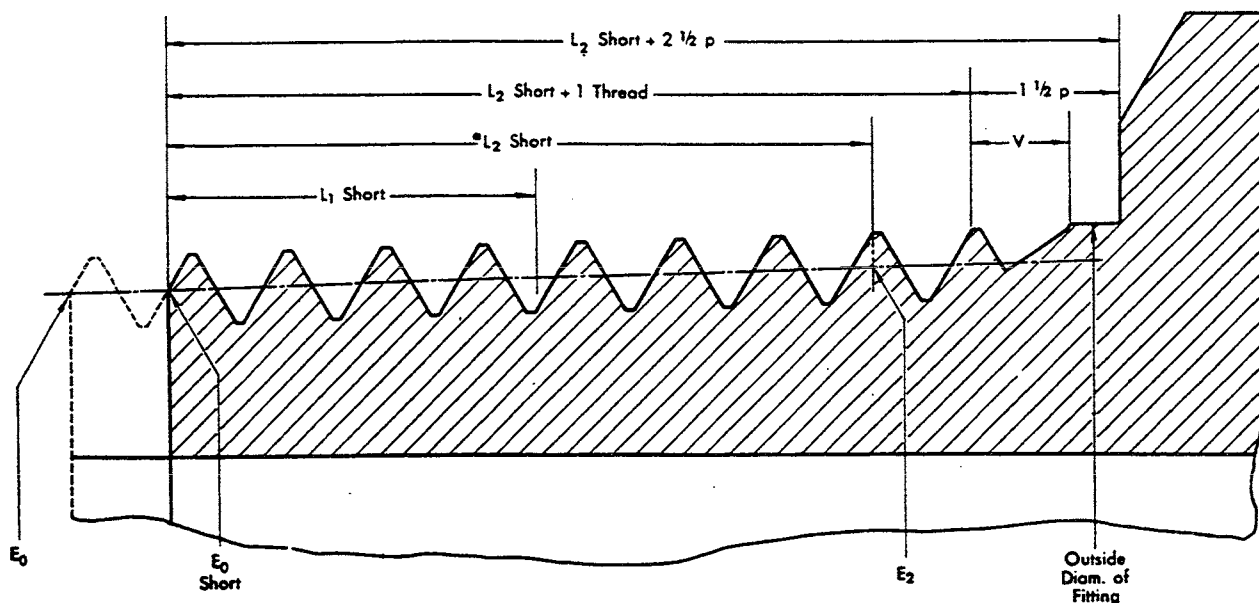
ANPT-AERONAUTICAL NATIONAL



NPTF-AMERICAN STANDARD (DRYSEAL)

Short Taper Threads (Dryseal)

PTF SAE Short



Nominal Pipe Size	Threads Per Inch	E_0 Short Pitch Diameter at Small End	L_1 Short Hand-Tight Engagement	* L_2 Short Effective Thread Length	L_2 Short + $2\frac{1}{2}p$ Min. Length to Shoulder
1/16	27	.2735	.1230	.2241	.3167
1/8	27	.3658	.1244	.2268	.3194
1/4	18	.4809	.1722	.3462	.4851
3/8	18	.6155	.1844	.3522	.4911
1/2	14	.7629	.2486	.4623	.6409
3/4	14	.9721	.2676	.4743	.6528
1	11½	1.2191	.3130	.5958	.8132
1¼	11½	1.5626	.3330	.6198	.8372
1½	11½	1.8015	.3330	.6365	.8539
2	11½	2.2745	.3490	.6695	.8869
2½	8	2.7273	.5570	1.0125	1.3250
3	8	3.3484	.6410	1.0750	1.3875

NOTE: These threads are the same as the American Standard Dryseal Taper Pipe Threads (NPTF) except that they have been shortened by the removal of one thread from the small end. The thread form is the same as that shown on page 13 for NPTF threads. Pitch diameters E_0 and E_2 are the same as those given for the NPTF threads on page 14.

* ON STD. O.D. Pipe the effective thread length L_2 short includes approximately two threads slightly imperfect at the crest.

Straight Pipe Threads

General Information

Types of Straight Pipe Threads

In this section is given a general description of the most common types of straight threads used, terms applied and specifications of thread form and diameters.

The straight external threads are used for either free or loose fitting joints.

NPSL - American Standard Straight Pipe Thread for loose-fitting mechanical joints with locknuts and locknut pipe threads. This design provides for the largest diameter thread that is possible to cut on standard pipe. Straight internal locknut threads are most commonly used with these external threads and provide a loose fit.

The basic pitch diameter is equal to the pitch diameter of the American Standard Taper Pipe Thread (NPT) at the gaging notch. This is the same as the pitch diameter at the large end of the NPT internal taper pipe thread.

NPSM - American Standard Straight Pipe Thread for free-fitting mechanical joints. These straight pipe threads are often found more suited or convenient when using standard iron, steel or brass pipe for mechanical assemblies where there are no internal pressures.

For the convenience of those who might desire to use this type of straight pipe thread with an allowance, it is recommended that the allowance be subtracted from the diameter of the external thread according to the following schedule:

For 27 threads per inch	0.0025 inches
For 18 threads per inch	0.0030 inches
For 14 threads per inch	0.0040 inches
For 11 1/2 threads per inch	0.0050 inches
For 8 threads per inch	0.0070 inches

The basic diameter is equal to the pitch diameter of the American Standard Taper Pipe Thread (NPT) at the gaging notch. This is the same as the pitch diameter at the large end of the NPT internal taper pipe thread.

NPSH - American Standard Hose Coupling Thread for steam, water, air, oil and all other hose connections of 1/2 to 2 inches inclusive, not covered by NH. Applies to both hose couplings and nipples.

NH - American Standard Hose Coupling Thread for garden hose, chemical engine and booster hose, and fire protection hose connections of 1/2 to 1 1/2 inches inclusive. Applies to both hose couplings and nipples.

NH - American Standard Fire-Hose Coupling Thread for fire hose connections of 2 1/2 to 4 1/2 inches inclusive. Applies to both fire hose couplings and nipples.

Although hose coupling connections are ordinarily made with straight internal and straight external loose fitting threads, the NPSH threads make it possible to join small hose couplings to the end of standard pipe with external taper pipe threads (NPT) by using a gasket to seal the joint.

Pressure-Tight Joints with Taper External and Straight Internal Pipe Threads

Taper external and taper internal pipe threads are most widely used for pipe joints. However, pressure-tight joints are sometimes made with taper external and straight internal pipe threads. The types of straight internal pipe threads most commonly used are listed here for informative purposes. In using these threads, one or both of the threaded external and internal members are considered to be sufficiently ductile to adjust themselves to each other. The resulting joints are recommended for comparatively low pressures only.

NPSC - American Standard Straight Pipe Thread (Internal) for pipe couplings with pressure-tight joints and used with lubricant or sealer. These straight internal threads are joined with the NPT standard taper external pipe thread. In the case of internal threads the letter "C" in the symbol indicates coupling.

NPSF - American Standard Internal Straight Pipe Thread (Dryseal) for pressure-tight joints. It is used without lubricant or sealer. These straight internal threads are joined with the standard NPTF taper external pipe thread (Dryseal) and are used for such applications as automotive, fuel and oil line fittings, drain plugs and filler plugs.

NPSI - American Standard Intermediate Internal Straight Pipe Thread (Dryseal) is primarily intended for assembly with PTF-SAE short, but will assemble with NPTF taper external (Dryseal) threads. It is used without lubricant or sealer. Nominal sizes and thread form are the same as NPSF but diameters are slightly larger. This thread is used extensively in hard and brittle materials of heavy section where there is little give in assembly with external taper pipe thread.

Pipe Threads for Holding Bung Plugs in Steel Barrels or Drums

These specifications are special and cover the straight pipe threads used for holding the bung plugs in steel barrels or drums. These threads are similar to the American Standard Straight Pipe Threads (NPSM) for

free-fitting mechanical joints, except that the external threads have a slightly smaller pitch diameter and the diameter tolerances are wider than those for the NPSM threads. The purpose of these differences is to provide a greater allowance between the external and internal thread and thereby insure proper seating of the plug flange when making up the joint with a gasket.

The dimension of the external threads are as follows:

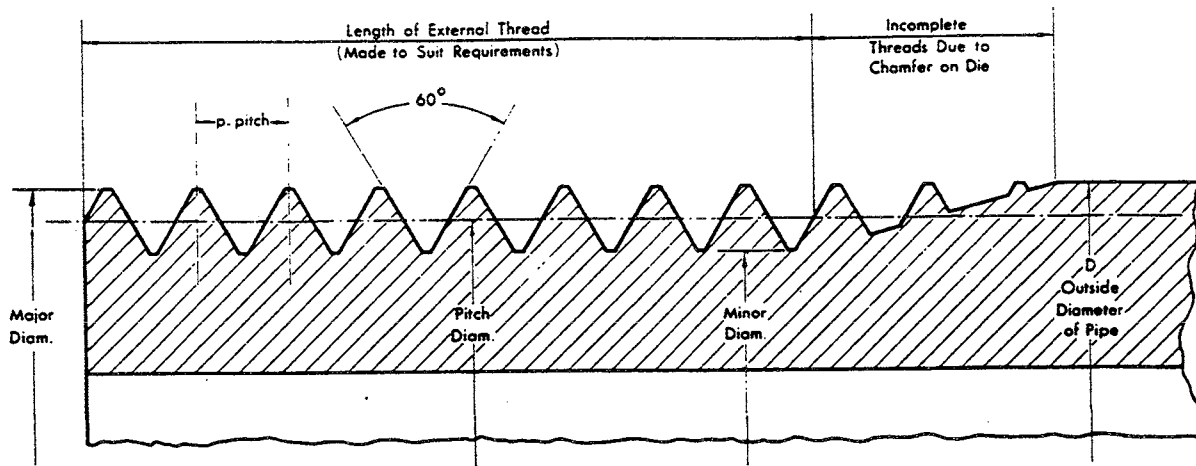
Nominal pipe size	3/4"	1 1/2"	2"
Threads per inch	14	11 1/2	11 1/2
Major diameter, max.	1.0306	1.8683	2.3411
min.	1.0154	1.8483	2.3250
Pitch diameter, max.	.9830	1.8104	2.2832
min.	.9754	1.8004	2.2720
Minor diameter, max.	.9354	1.7525	2.2253

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 threads of these parts are established by the I.C.C. The thread form is that developed by the Manufacturing Chemical Association of the United States. The principal external thread dimensions on the plug are:

- Major diameter = 2.287" max., 2.277" min.
- Pitch diameter = 2.1887"
- Minor diameter = 2.1004" max., 2.0904" min.
- Length of Thread = 11/16" plus 1/8" recess

Terms

for External Straight Pipe Threads



Complete Thread

The complete thread is that part of the thread having full form at both crest and root. General specifications relating to chamfers on NPT external taper threads, as outlined on page 11, also apply to external straight threads.

Incomplete Threads

On straight threads, the incomplete thread is that portion at the end having roots not fully formed by the chamfer or bevel on the thread rolling dies.

Thread Length L_2

The thread length L_2 is specified to suit requirements and should be for the length of the completer thread.

Major Diameter

The major diameter is the diameter of the imaginary cylinder which bounds the crest of an external thread.

The basic outside diameter of the pipe is usually equal to the maximum major diameter of the pipe thread, although for special designs the diameters of the portion of the pipe carrying the thread may be different.

Pitch Diameter

The pitch diameter of a straight external thread is the diameter of the imaginary cylinder, the surface of which would pass through the thread profile at such points as to make the width of thread and groove equal. This width is equal to one-half of the basic pitch.

The basic pitch diameter for external straight pipe threads NPSH, NPSL and NPSM, is equal to the pitch diameter at the large end of the American Standard internal taper pipe thread. This pitch diameter is referred

to as E_1 and is located L_1 distance for the E_0 diameter on the external taper thread at the small end of the pipe. The basic pitch diameter E_1 is based on the following formulas used for taper pipe threads:

$$E_1 = E_0 + .0625 L_1$$

where:

E_1 = Pitch diameter of thread

$E_0 = D - (.050D + 1.1) 1/n$

D = Basic outside diameter of pipe

n = Threads per inch

L_1 = Normal length of engagement between internal and external taper thread when tightened by hand

Minor Diameter

The minor diameter is the diameter of the imaginary cylinder which bounds the root of an external thread.

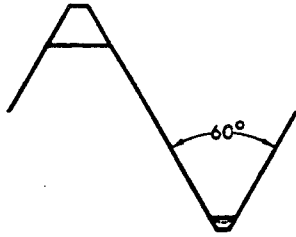
Pitch and Angle of Thread

The pitch and angle of thread for the NPSH, NPSL and NPSM straight external threads are the same as the corresponding dimensions of the American Standard Taper Pipe Threads.

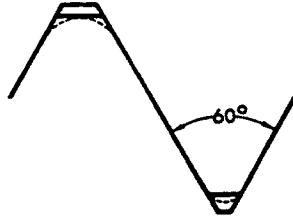
Height (Depth) of Thread

The height (depth) of thread differs with the various straight external threads. Refer to page 21 for specific information relative to height of thread and truncation and width of flat of both root and crest.

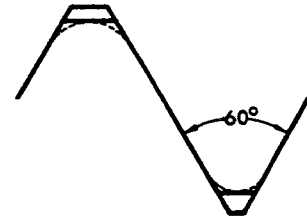
Thread Form Specifications for External Straight Pipe Threads



NPSL
American Standard
for Locknuts



NPSM
American Standard
for Mechanical Joints



NPSH and NH
American Standard
Hose Couplings

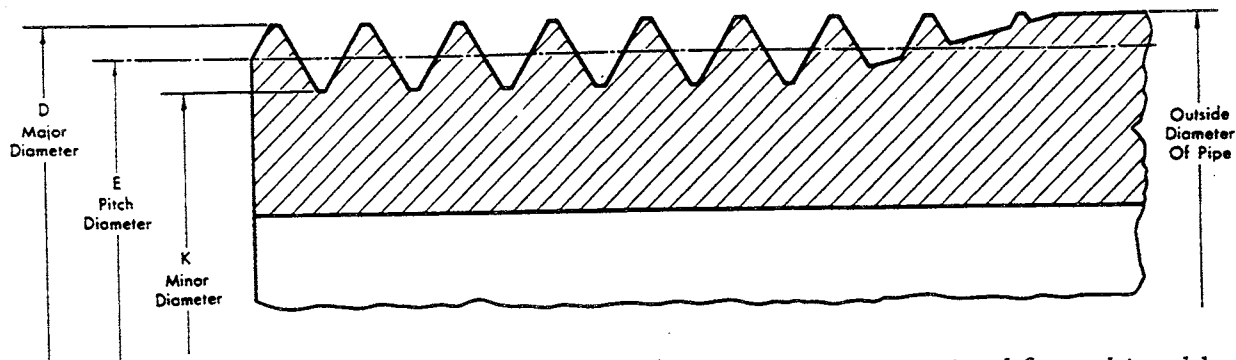
Note: The dotted radii show the permissible rounding due to worn tools.

Thds. per Inch	Pitch	NPSL-Amer. Std. for Locknuts						NPSM-Amer. Std. for Mech. Joints					
		*Crest Flat		Root Flat		*Height		Crest Flat		Root Flat		Height	
		Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
27	.0370	.0082	.0022	.0041	.0014	.0290	.0214	.0060	.0045	.0042	.0014	.0269	.0232
18	.0556	.0124	.0034	.0057	.0021	.0434	.0324	.0092	.0064	.0064	.0021	.0408	.0346
14	.0714	.0160	.0045	.0064	.0027	.0556	.0425	.0119	.0085	.0080	.0027	.0521	.0446
11½	.0870	.0195	.0056	.0073	.0033	.0676	.0521	.0147	.0104	.0098	.0033	.0635	.0541
8	.1250	.0279	.0079	.0090	.0048	.0973	.0764	.0210	.0146	.0143	.0048	.0915	.0777

Thds. per Inch	Pitch	NPSH-Amer. Std. Hose Coupling						NH Threads					
		Crest Flat		Root Flat		Height		Crest Flat		Root Flat		Height	
		Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
14	.0714	.0129	.0089	.0089	.0030	.0515	.0430						
11½	.0870	.0158	.0109	.0108	.0036	.0628	.0523	.0158	.0109	.0108	.0036	.0628	.0523
9	.1111							.0203	.0139	.0139	.0046	.0802	.0666
8	.1250							.0220	.0156	.0156	.0052	.0902	.0757
7½	.1333							.0259	.0167	.0167	.0056	.0961	.0786
6	.1667							.0312	.0208	.0208	.0069	.1204	.0993
4	.2500							.0457	.0312	.0312	.0104	.1805	.1499

* Crest flats for NPSL threads are determined by the relationship of the pitch diameter to the outside diameter of the pipe. These crest flats are usually not formed by the threading tools, but are the remaining outside surface of the pipe after the thread has been formed. This condition will also control the heights of these threads.

Diameters of External Straight Pipe Threads



Note: 5" through 12" NPSL sizes and 5" and 6" NPSM sizes are omitted from this table.

Pipe Size	T.P.I.	Outside Diam. of Pipe	NPSL-Amer. Standard for Locknuts					NPSM-Amer. Std. for Mech. Joints				
			*Major Diam.		Pitch Diam.		Minor	Major Diam.		Pitch Diam.		Minor
			Max.	Min.	Max.	Min.	Max.	Max.	Min.	Max.	Min.	Max.
1/8	27	.405	.409	.402	.3840	.3805	.359	.399	.393	.3748	.3713	.350
1/4	18	.540	.541	.530	.5038	.4986	.466	.527	.516	.4899	.4847	.453
3/8	18	.675	.678	.668	.6409	.6357	.603	.664	.654	.6270	.6218	.590
1/2	14	.840	.844	.831	.7963	.7896	.746	.826	.813	.7784	.7717	.731
3/4	14	1.050	1.054	1.041	1.0067	1.0000	.956	1.036	1.023	.9889	.9822	.941
1	11½	1.315	1.318	1.302	1.2604	1.2523	1.198	1.296	1.280	1.2386	1.2305	1.181
1 ¼	11½	1.660	1.663	1.647	1.6051	1.5970	1.543	1.641	1.625	1.5834	1.5753	1.526
1 ½	11½	1.900	1.902	1.886	1.8441	1.8360	1.782	1.880	1.864	1.8223	1.8142	1.764
2	11½	2.375	2.376	2.360	2.3180	2.3099	2.255	2.354	2.338	2.2963	2.2882	2.238
2 ¼	8	2.875	2.877	2.853	2.7934	2.7817	2.701	2.846	2.822	2.7622	2.7505	2.679
3	8	3.500	3.503	3.480	3.4198	3.4081	3.327	3.472	3.448	3.3885	3.3768	3.305
3 ½	8	4.000	4.003	3.980	3.9201	3.9084	3.827	3.972	3.949	3.8888	3.8771	3.806
4	8	4.500	4.502	4.478	4.4184	4.4067	4.326	4.470	4.447	4.3871	4.3754	4.304

* The major diameter of the NPSL thread is usually determined by the outside diameter of the pipe. The maximum diameter given is larger than the nominal pipe diameter because of the normal variation in diameter produced by the pipe manufacturers.

Size of Hose	NPSH-Amer. Std. Hose Coupling						NH Threads					
	T.P.I.	Major Diam.		Pitch Diam.		Minor	T.P.I.	Major Diam.		Pitch Diam.		Minor
		Max.	Min.	Max.	Min.	Max.		Max.	Min.	Max.	Min.	Max.
1/2	14	.825	.811	.7784	.7714	.732	a 11½	1.063	1.046	1.0060	.9975	.950
5/8							a 11½	"	"	"	"	"
3/4	14	1.035	1.021	.9889	.9819	.943	a 11½	"	"	"	"	"
3/4							b 8	1.375	1.353	1.2938	1.2827	1.213
1	11½	1.295	1.278	1.2386	1.2301	1.182	b 8	"	"	"	"	"
1 ¼	11½	1.640	1.623	1.5834	1.5749	1.527	c 9	1.990	1.968	1.9178	1.9067	1.846
1 ½	11½	1.879	1.862	1.8223	1.8138	1.766						
2	11½	2.353	2.336	2.2963	2.2878	2.240	d 7 ½	3.069	3.037	2.9820	2.9660	2.895
2 ¼							d 6	3.624	3.588	3.5156	3.4976	3.407
3							d 6	4.244	4.208	4.1356	4.1176	4.027
3 ½							d 4	5.761	5.711	5.5985	5.5735	5.436
4 ½												

- a. Garden Hose.
- b. Chemical Engine and Booster Hose.
- c. Fire-Protection Hose.
- d. Fire Hose.

Approximate Blank Diameters

For American Standard External Taper Pipe Threads—NPT and NPTF

Pipe Size	Approximate Dimensions of Blanks			
	A	B (Ref.)	C	L ₂
1/16-27	.271	.288	.233	.261
1/8-27	.364	.380	.322	.264
1/4-18	.477	.503	.424	.402
3/8-18	.612	.638	.560	.408
1/2-14	.758	.792	.692	.534
3/4-14	.968	1.002	.902	.546
1-11 1/2	1.214	1.256	1.136	.683
1 1/4-11 1/2	1.557	1.601	1.480	.707
1 1/2-11 1/2	1.796	1.841	1.718	.724

For American Standard External Taper Pipe Threads—PTF SAE (Short Dryseal)

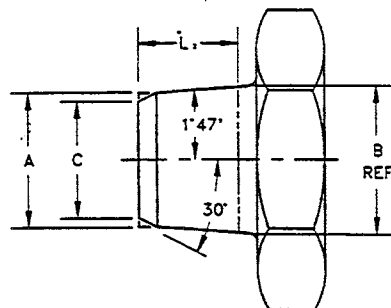
Pipe Size	Approximate Dimensions of Blanks			
	A	B (Ref.)	C	L ₂
1/16-27	.274	.288	.236	.224
1/8-27	.366	.380	.324	.227
1/4-18	.481	.503	.428	.346
3/8-18	.616	.638	.564	.352
1/2-14	.763	.792	.697	.462
3/4-14	.972	1.002	.906	.474
1-11 1/2	1.219	1.256	1.141	.596
1 1/4-11 1/2	1.563	1.601	1.486	.620
1 1/2-11 1/2	1.802	1.841	1.724	.636

A = Approximate pitch diameter at small end

B = Approximate pitch diameter at large end

C = A (Thread depth + 010)

L₂ = Effective thread length



Notes