Thread

1 Definition

The diameters, threads per inch (TPI) and thread pitch, etc. are necessary to completely identify a thread. In a shop, specialty gauges are required to accurately gauge or identify threads. In the field, in the absence of these gauges, thread "leaf" gauges can be used to identify the "Threads per Inch" (TPI) and the thread pitch. On threads you have determined to be straight threads, a caliper can be used to measure the "Outside Diameter of the Male" (ODM) or the "Inside Diameter of the Female" (IDF). A caliper can also be used to take measurements of tapered thread diameters. However, these are more difficult to define because of the taper. Fortunately, there are few tapered threads to deal with and these can usually be identified from the nominal ODM and the TPI.

However, identifying the thread may not fully identify what is needed in a mating fitting. The application is the primary **limiting factor on the thread type used.** We offer products with a wide variety of threads used with hose, pipe and hydraulics.

When attempting to choose a fitting, it is always advisable to first identify the thread to which it must connect. This may entail checking with a fitting or equipment manufacturer.

The fire hose thread specifications for some local municipal fire equipment and hydrants may vary according to local specifications. These can generally be most easily identified by contacting the local fire department responsible for the hydrant. The most common thread used on fire equipment is National Standard Thread (NST), also known as National Hose thread (NH).

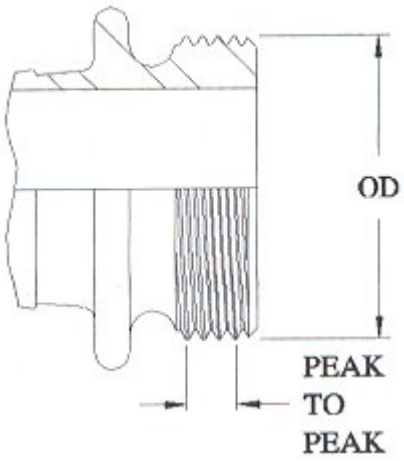
When it is not possible to identify the thread:

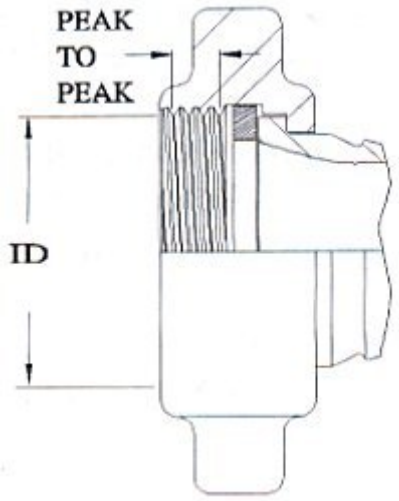
- **1)** Determine the number of threads per inch by measuring the distance from peak of thread to peak of thread across the largest number of whole threads. Then divide the number of threads by the measurement. (This will provide the TPI).

2) Check to see if the thread is straight or tapered.
a) Straight Threads
Measure the "Outside Diameter of the Male" (ODM) or the "Inside Diameter of the Female" (IDF), from peak of thread to peak of thread.
b) Tapered Threads
Measure the "Outside Diameter of the Male" (ODM) at the large end and the small end, or the "Inside Diameter of the Female" (IDF) at the large end and the

small end, from peak of thread to peak of thread.

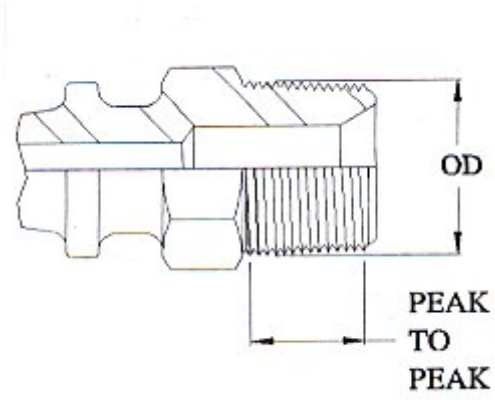
Straight Thread

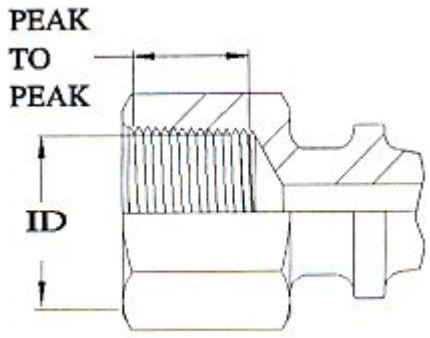




Male **Female**

Tapered Thread





Male **Female**

Threading Information

Abbreviation	System Name	Compatibility	Seal Method
BSPP	**B**ritish **S**tandard **P**ipe **P**arallel	Male BSPP with Female BSPP	Washer
		Female BSPP with Male BSPP	Washer
		Female BSPP with Male BSPTr	Washer
BSPTr	**B**ritish **S**tandard **P**ipe **T**aper	Male BSPTr with Female BSPTr	Thread
		Male BSPTr with Female BSPP	Washer
		Female BSPTr with Male BSPTr	Thread
		Female BSPTr not compatible with Male BSPP	
CHT	American Standard Fire Hose Thread (1" National Hose Thread is **C**hemical **H**ose **T**hread, also known as Booster Hose Thread)	1"Male NH (NST) with 1" Female NH (NST)	Washer
		1" Female NH (NST) with 1" Male NH (NST)	Washer
		1" Thread is used on both ¾" hose & 1" hose.	
		Not compatible with other systems	
GHT	**G**arden **H**ose **T**hread	Male GHT with Female GHT	Washer
		Female GHT with Male GHT	Washer
		Thread is the same for all size hose.	
		Not compatible with other systems	
IPS	**I**ron **P**ipe **S**traight Thread	Generic name for Straight Pipe Thread	Washer
		See NPSH for compatibility	
JIC	**J**oint **I**ndustrial **C**ommittee	Used with other mating JIC threads	Mechanical
NH or NST	American Standard Fire Hose Coupling Thread (**N**ational **H**ose thread also known as **N**ational **S**tandard **T**hread	Male NH (NST) with Female NH (NST)	Washer
		Female NH (NST) with Male NH (NST)	Washer
		Not compatible with other systems Thread pitch and diameters of fire	

		threads may vary according to local and municipal regulations.	
NPT	American Standard Taper Pipe Thread (**N**ational **P**ipe **T**hread	Male NPT with Female NPT	Thread
		Male NPT with Female NPTF	Thread
		Male NPT with Female NPSM	Washer
		Male NPT with Female NPSH	Washer
		Female NPT with Male NPT	Thread
		Female NPT with Male NPTF	Thread
		Female NPT not compatible with Male NPSM or Male NPSH	
NPTF	American Standard Taper Pipe Fuel Dryseal Thread (**N**ational **P**ipe **T**apered **F**ine)	Male NPTF with Female NPTF	Thread
		Male NPTF with Female NPT	Thread
		Male NPTF with Female NPSM	Washer
		Male NPTF with Female NPSH	Washer
		Female NPTF with Male NPTF	Thread
		Female NPTF with Male NPT	Thread
		Female NPTF with Male NPSM or Male NPSH	***Not Compatible***
		Note: NPTF with NPTF threads do not require sealant for the initial use. After that, sealant is required.	
NPSH	American Standard Straight Pipe for Hose Couplings (**N**ational **P**ipe **S**traight **H**ose)	Male NPSH with Female NPSH	Washer
		Female NPSH with Male NPSH	Washer
		Female NPSH with Male NPT	Washer
		Female NPSH with Male NPTF	Washer
		Female NPSH with Male NPSM	Washer
NPSM	American Standard Straight Mechanical Joints (**N**ational **P**ipe **S**traight **M**echanical)	Male NPSM with Female NPSM	Seal can be either mechanical or washer. Mating fittings must be of same type
		Male NPSM with Female NPSH	
		Female NPSM with Male NPSM	
		Female NPSM with Male NPT	
		Female NPSM with Male NPTF	
TIPT	**T**apered **I**ron **P**ipe **T**hread	Generic name for Tapered Pipe Thread	Thread

Thread Dimensions

Nominal Dimensions of Standard Threads

Size	Pipe O. D.	NPT	NPSH			NPSM		
		TPI	TPI	ODM (Max)	IDF (Min)	TPI	ODM (Max)	IDF (Min)
1/8"	.405	27	-	-	-	27	0.397	0.358
1/4"	.504	18	-	-	-	18	0.526	0.468
3/8"	.675	18	-	-	-	18	0.662	0.603
1/2"	.840	14	14	0.8248	0.7395	14	0.823	0.747
3/4"	1.050	14	14	1.0353	0.9500	14	1.034	0.958
1"	1.315	11.5	11.5	1.2951	1.1921	11.5	1.293	1.201
1-¼"	1.660	11.5	11.5	1.6399	1.5369	11.5	1.638	1.546
1-½"	1.900	11.5	11.5	1.8788	1.7758	11.5	1.877	1.785
2"	2.375	11.5	11.5	2.3528	2.2498	11.5	2.351	2.259
2-½"	2.875	8	-	-	-	8	2.841	2.708
3"	3.500	8	-	-	-	8	3.467	3.334
4"	4.500	8	-	-	-	8	4.466	4.333
5"	5.563	8	-	-	-	8	5.528	5.395
6"	6.625	8	-	-	-	8	6.585	6.452
8"	8.625	8	-	-	-	-	-	-
10"	10.750	8	-	-	-	-	-	-
12"	12.750	8	-	-	-	-	-	-

ODM = Outside Diameter of Male
IDF = Inside Diameter of Female
TPI = Threads per Inch
GHT (¾") = 1.0625 ODM, 11-½ TPI

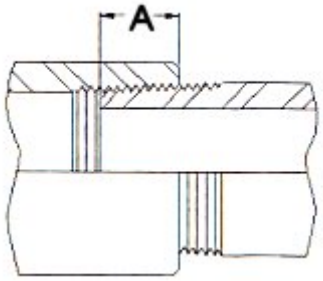
Size	Pipe O. D.	NH (NST)			BSPP (Parallel)			BSPTr (Tapered)
		TPI	ODM (Max)	IDF (Min)	TPI	ODM (Max)	IDF (Min)	TPI
1/8"	.405	-	-	-	-	0.383	0.337	28
1/4"	.504	-	-	-	-	0.516	0.450	19
3/8"	.675	-	-	-	-	0.656	0.588	19

1/2"	.840	-	-	-	-	0.825	0.733	14
3/4"	1.050	8	1.375	1.2246	-	1.041	0.950	14
1"	1.315	8	1.375	1.2246	11	1.309	1.193	11
1-¼"	1.660	-	-	-	-	1.650	1.534	11
1-½"	1.900	9	1.990	1.8577	11	1.882	1.766	11
2"	2.375	-	-	-	-	2.347	2.231	11
2-½"	2.875	7.5	3.068	2.9104	11	2.960	2.844	11
3"	3.500	6	3.623	3.5306	11	3.460	3.344	11
4"	4.500	4	5.010	4.7111	11	4.450	4.334	11
4-½"	-	4	5.760	5.4611	-	-	-	-
5"	5.563	4	6.260	5.9602	11	5.450	5.359	11
6"	6.625	4	7.025	6.7252	11	6.450	6.359	11

ODM = Outside Diameter of Male
IDF = Inside Diameter of Female
TPI = Threads per Inch
GHT (¾") = 1.0625 ODM, 11-½ TPI

NOTE: Female NPT (Tapered Pipe) thread is not available on hose swivel nuts.

Normal Engagement Length of NPT Thread in Inches ("A") *

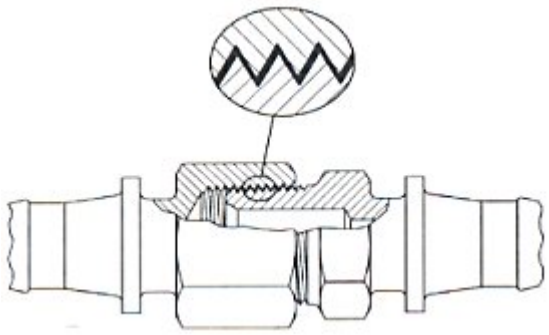


Size	**1/8"**	**1/4"**	**3/8"**	**1/2"**	**3/4"**	**1"**	**1-¼"**	**1-½"**	**2"**
Length	1/4"	3/8"	3/8"	1/2"	9/16"	11/16"	11/16"	11/16"	3/4"

Size	**2-½"**	**3"**	**4"**	**5"**	**6"**	**8"**	**10"**	**12"**

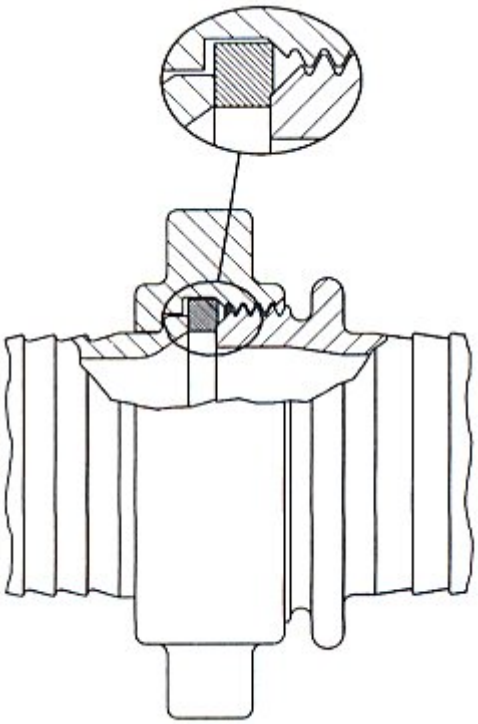
Length	15/16"	1"	1-1/8"	1-1/4"	1-5/16"	1-7/16"	1-5/8"	1-3/4"
***** Dimensions given do not allow for variations in tapping or threading								

Thread Sealing Tips



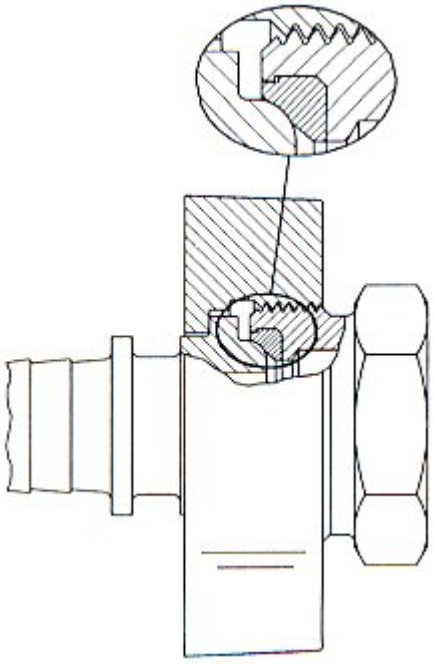
Thread Seal Type

- A seal is obtained by applying a sealant to the male thread before engaging.
- The sealant is used to prevent spiral leakage.
- Thread tape or paste is the preferred sealant in this type of application.



Washer Seal Type

- A seal is obtained when the male thread is tightened down onto the washer of the female assembly.
- The washer should be inspected regularly and replaced as needed to prevent leakage.



Mechanical Seal Type

- A seal is obtained through metal to metal contact or metal to seal contact, for example JIC couplings have a metal to metal seal. EZ-Boss Ground Joint couplings have a metal to seal contact (shown at left).
- The couplings should be retightened as needed to prevent leakage.

More Thread Sealing Tips...

Sealing NPT threads can be an exasperating experience if certain techniques are not followed. The following tips will help alleviate many common problems in thread sealing:

- **1.** Always use some type of sealant (tape or paste) and apply sealant to male thread only. If using a hydraulic sealant, allow sufficient curing time before system is pressurized.
- **2.** When using tape sealant, wrap the threads in a clockwise motion starting at the first thread and, as layers are applied, work towards the imperfect (vanishing) thread. If the system that the connection being made to cannot tolerate foreign matter (i.e. air systems), leave the first thread exposed and apply the tape sealant as outlined above.
- **3.** When using paste sealant,
- **6.** For sizes 2" and below, tape or paste usually performs satisfactorily. When using thread tape, four wraps (covering all necessary threads) is usually sufficient.
- **7.** For sizes 2-½" and above, thread paste is recommended. If thread tape is used, eight wraps (covering all necessary threads) is usually sufficient. Apply more wraps if necessary.
- **8.** For stubborn to seal threads, apply a normal coating of thread paste followed by a normal layer of thread tape.
- **9.** For **extremely** stubborn to seal threads, apply a normal

apply to threads with a brush, using the brush to work the sealant into the threads. Apply enough sealant to fill in all the threads all the way around.

- **4.** When connecting one stainless steel part to another stainless steel part that will require future disassembly, use a thread sealant that is designed for stainless steel. This stainless steel thread sealant is also useful when connecting aluminum to aluminum that needs to be disconnected in the future. These two materials gall easily, and if the correct sealant is not used, it can be next to impossible to disassemble.
- **5.** When connecting parts made of dissimilar metals (i.e. steel & aluminum), standard tape or paste sealant usually performs satisfactorily.

coating of thread paste followed by a single layer of gauze bandage followed by a normal layer of thread tape.

Caution!

When this procedure is done, the connection becomes permanent. Extreme measures will be necessary to disconnect these components. All other measures to seal the threads should be explored prior to the use of this technique.

- **10.** Over-tightening threads can be just as detrimental as insufficient tightening. For sizes 2" and below, hand tighten the components and, with a wrench, tighten 3 full turns. for sizes 2-½" and above, hand tighten the components and, with a wrench, tighten 2 full turns.

2 Pipe Thread Standards

Two common pipe thread standards exist:

- National Pipe Thread (NPT) - a tapered thread
- National Standard Free-Fitting Straight Mechanical Pipe Thread (NPSM) - a straight thread

Less common standards also exist:

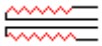
- Garden Hose Thread (GHT)
- Fire Hose Coupling (NST)
- British Standard Taper Pipe Thread (BSPT)

Female NPT threads can be designated as "FPT" and male NPT threads can be designated as "MPT." I have also seen female NPT threads designated as "FNPT" and male as "MNPT".

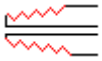
Straight Versus Tapered Threads

Threaded pipe can be connected to join things together, which does not necessarily produce a leakproof seal, or they can be joined and sealed.

Straight threads only provide a mechanical junction. They don't really seal.



Tapered threads both join and seal. The deeper you drive them, the tighter the seal.



Pipe Thread Tape

Whenever you want a good seal when screwing together pipes and fittings, use pipe thread tape. This is usually made of PTFE, the most famous brand of which is Teflon.

In addition to sealing, pipe thread tape also lubricates the joint, which:

- makes it easier to tighten it
- makes it easier to disassemble the joint in the future
- reduces/eliminates thread galling [Thread galling is when threads weld themselves together. This is more common with pipes and fasteners made from alloys that protect themselves from corrosion by developing their own oxide surface film, like aluminum and stainless steel.

Standard Pipe Sizes

Pipe sizes do not refer to any physical dimension of modern pipe. If you measure a piece of 1/4" NPT pipe, you will have a hard time finding anything there that measures 1/4".

Historical note:

- The sizes derive from the days when pipes were made of iron, pipe walls were rather thick, and the internal diameter (ID) was standardized. At that time, if you specified a 1/2" pipe, it had an internal diameter of 1/2", and an outer diameter that depended on the thickness of the wall.
- Nowadays, the standards measure the threaded part of the pipe, the outer diameter (OD). This lets thin-wall and thick-wall pipe use the same fittings.

- But we kept the same names, so when you say 1/2″ pipe, you get a pipe whose outer diameter is the same as that of an old-fashioned iron pipe whose inner diameter was 1/2″.

In order to get the right size, you should measure the outer diameter (OD) of the pipe, and look it up in a table to find out what it is officially called. It's also a good idea to measure the threads per inch (TPI). The combination of OD and TPI provide positive identification of standard pipe sizes.

Pipe Thread Size	Threads per Inch	OD Fraction (approximate)	OD Decimal (actual)	Normal depth for tight joint
1/16″	27	5/16″	0.3125″	0.2611″
1/8″	27	13/32″	0.405″	0.2639″
1/4″	18	35/64″	0.540″	0.4018″
3/8″	18	43/64″	0.675″	0.4078″
1/2″	14	27/32″	0.840″	0.5337″
3/4″	14	1-3/64	1.050″	0.5457″
1″	11-1/2	1-5/16″	1.315″	0.6828″
1-1/4″	11-1/2	1-21/32″	1.660″	0.7068″
1-1/2″	11-1/2	1-29/32″	1.900″	0.7235″
2″	11-1/2	2-3/8″	2.375″	0.7565″
2-1/2″	8	2-7/8″	2.875″	1.1375″
3″	8	3-1/2″	3.5″	1.2000″
3-1/2″	8	4″	4.0″	1.2500″
4″	8	4-1/2″	4.5″	1.3000″