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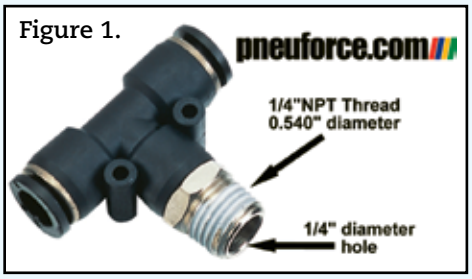
PIPE THREADS

The most important point to understand about pipe threads is that their size refers to the diameter of the hole going through the fitting (where the media travels such as air or oil, etc), not the diameter of the thread itself. This is sometimes confusing to the fluid power novice. Figure 1 highlights this using a 1/4"NPT threaded fitting as an example.

Male tapered fittings, as shown in Figure 1, use a thread sealant of some kind to seal against the female thread. This sealant can either be manually applied using a PTFE thread tape, or, as also shown in Figure 1, pre-coated threads are commonly available particularly with push-to-connect or push-in fittings as shown. There are two major types of pipe thread forms used in the industrial world: BSP and NPT. The differences and origins of which are explained as follows.

Figure 1.



British Standard Pipe Threads (BSP)

The most widely used thread form in the world is the so-called "metric" thread. This thread form is the most common standard pipe thread across the globe, and in fact, the only industrialized countries not to adopt it officially are the USA and Canada. The term "metric," which is used to describe the British Standard Pipe thread, is by definition not a metric thread. The BSP thread form is based on the Whitworth standard, born through the design of Joseph Whitworth, a British engineer from the 1800's. The Whitworth thread form, which is defined by a 55-degree thread angle, was adopted by the British railway system during the industrial boom of Britain during the 1800's, and consequently, engineering houses across the country were forced to comply with this new standard. This thread fastener (nuts and bolts) standard was adopted for use with pipe connections. Due to the large British Empire of the day, the rest of the world quickly followed suit.

The reason it is referred to as a "metric" thread is because the Americans are referring to the metric standards used throughout Europe and the rest of the world. However a metric 1/4" pipe thread is obviously referring to a quarter of an inch, which is, of course, not metric.

There are two types of BSP threads, one being parallel (BSPP) and the other being tapered (BSPT). In the very large majority of cases, the female thread used in valves, cylinders and other fluid power apparatus is a parallel and the male thread, which is used primarily for the fittings or connectors, is tapered. It is unusual to find a BSPT female thread.

The majority of pneumatic or fluid power installations screw a tapered male into a female parallel. Of course this is not ideal as the fitting will only seal on two or three threads, but on low-pressure systems, this is more than adequate. The ideal connection should be a parallel male screwing into a parallel female (BSPP) where the actual thread seal is made by compressing a gasket, washer or "O" ring against the sealing or mating face. However, male BSPP threads are not as commonly used as BSPT threaded male fittings. One of the advantages of a tapered thread is the ability to tighten down to a chosen orientation depending on the torque applied. Connection of a centre back mounted gauge, for example, is best with a tapered thread so that the 12 o'clock is vertical.

The term "G thread" is referring to BSPP and is written as G1/4, which is a 1/4" British Standard Pipe Parallel. The term "R thread" is referring to BSPT and is written

as R1/4, which is a 1/4" British Standard Pipe Taper. Table 1 shows the basic thread data associated with the BSP threads.

National Pipe Threads

Referred to as "NPT," this is the official pipe thread for the USA and Canada. However, it is not used in Mexico and the vast majority of the Caribbean, which uses the BSP thread form. Of course across the whole continent, there is a big mismatch of threads, and this is simply because of the import of goods from countries across the globe.

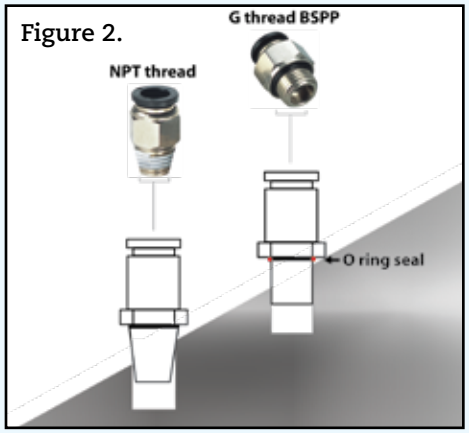
The NPT thread, although visually similar to the BSPT (R) thread, is not the same. There is some compatibility, but the fundamentals of the thread forms are different, such as the major diameters, root and crest design and the all important thread pitch. Table 2 shows the basic thread data for NPT threads.

The interchangeability of NPT is either not known or not understood by the user. Table 3 highlights the compatibility of the BSP and NPT thread sizes.

Significant manufacturers, such as automotive producers, are rumored to be standardizing on the BSP thread form, but this will take time. The reason for this is international compatibility as both of these manufacturers operate across the globe. Machine builders and large suppliers to these users will be requested to conform to this thread form, and this is why the BSP thread form will, in time, probably be the pipe thread standard.

NPT and BSPT have no technical advantages over each other, but there are basic advantages of the BSPP (G) thread, such as a simple seal using a gasket, consistent thread tightening depth, which offers equal or consistent height or fitting protrusion among an array of components. This is important when you consider the amount of thread tape or sealant applied or the torque used or indeed the machining tolerances on a tapered thread that vary. These alone are good reasons to use a parallel thread form. The only obvious disadvantage of a parallel thread, which requires a gasket to seal, is when a male fitting is screwed into an angled face where the two sealing surfaces are not square to each other or even flat. Figure 2 highlights this comparison graphically.

Figure 2.



Summary

Pipe threads are a fundamental feature of any fluid power component. Is there an absolute best thread form? No. However, what should be noted is that NPT and BSP are not fully interchangeable, and wherever possible, only one of the thread forms should be used on machinery. This is certainly of benefit to the end user who only has to stock one type of thread. It also eliminates the possible situation where a thread will simply not fit into another or leakage occurs.

More and more BSP threaded fittings are being sold in the USA and Canada today because of the importation of European machinery or even domestic manufacturers trying to standardize on a BSP thread system. However NPT is of course still the dominant thread form. The existence of this "two thread" system will be here for many years to come. The present trend in industry is gradually moving towards the "metric" thread and in fact the metric system is used already in such institutions such as the US military and certain medical fields.

For more information, contact Daniel Pascoe at www.vacuforce.com. Pneuforce.com is an international fluid power sourcing house and is a brand of Vacuforce Inc.

Table 1.

BSPT - British Standard Pipe Thread 1/8" through 2"		
Thread Size Inch	Threads Per Inch (TPI)	Outside Diameter (OD) Inches
1/8"	28	0.383
1/4"	19	0.518
3/8"	19	0.656
1/2"	14	0.825
3/4"	14	1.041
1"	11	1.309
1-1/4"	11	1.650
1-1/2"	11	1.882
2"	11	2.347

Table 2.

NPT - American Standard Pipe Thread Taper 1/8" through 2"		
Thread Size Inch	Threads Per Inch (TPI)	Outside Diameter (OD) Inches
1/8"	27	0.405"
1/4"	18	0.540"
3/8"	18	0.675"
1/2"	14	0.840"
3/4"	14	1.050"
1"	11.5	1.315"
1-1/4"	11.5	1.660"
1-1/2"	11.5	1.900"
2"	11.5	2.375"

Table 3.

Pipe Size	Threads Per Inch (Pitch)		Compatibility
	BSPT & BSPP	NPT	
1/8"	28	27	Male R screws into Female NPT
1/4"	19	18	Not Compatible
3/8"	19	18	Male NPT Screws into G Female by 2 or 3 threads
1/2"	14	14	Both threads connect together but leak without sealant
3/4"	14	14	Both threads connect together but leak without sealant
1"	11	11.5	Male NPT Screws into G Female by 2 or 3 threads