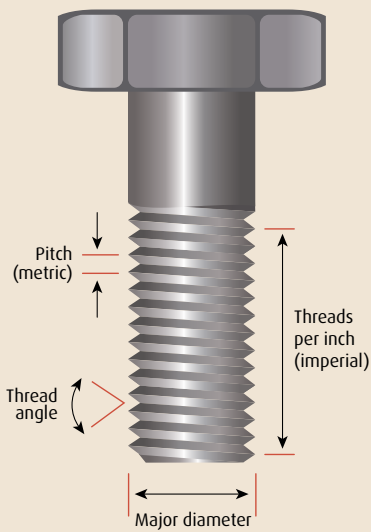




FIGURE 1 SCREW THREAD TERMS



Photos: Ben White and Josh Giunelli



Solving the thread mystery

One of the most time consuming tasks is trying to match up a mystery nut or bolt. Like some kind of cryptic puzzle, some threads defy identification. But a methodical approach, a little bit of know-how and some handy tools can make the life easier.

In a perfect world, all thread sizes would be standardised, but that is unfortunately not the case. Today, machinery and vehicles use mainly metric threads, or Unified National Coarse (UNC) and Unified National Fine (UNF).

Other less common threads include British Standard Whitworth (BSW), British Standard Fine (BSF), American National Fine (ANF) and American National Coarse (ANC).

Pipes and fittings generally have their own specified thread types, including British Standard Pipe Thread (BSP) and National Pipe Thread (NPT). BSPT (the T means the thread is tapered) is commonly used in all water pipe fittings today.

Step one: country of origin

Often a machine's country of origin can provide a clue as to the fastener thread types. For example, machinery made in Europe will use metric threaded fasteners, while North American machinery will feature fasteners with UNF or UNC threads.



Older British machinery will invariably use BSW or BSF threads, which are a real pain as taps and dies can be difficult to source. A fair indication you've struck a Whitworth bolt is when you find neither metric or imperial spanners fit the bolt head. If you have some old Whitworth spanners hanging around then you're in luck.



Step two: look for markings

Life would be a lot easier if fastener manufacturers simply marked the size on the head of the bolt. Unfortunately, this is not the case. But bolt head markings can help identify the type of thread used. The radial lines on the left-hand bolt are used to indicate the bolt grade on imperial fasteners. The more lines the higher the grade. The centre bolt is marked with 8.8, which is the grade marking for a grade eight metric fastener. The right-hand bolt is a mystery thread and should always be assumed to be of low-grade strength irrespective of its thread type.



Step three: measure the diameter

The next step is to measure the diameter of the threaded section, which will provide a strong clue as to whether the thread is metric or imperial. A metric thread will very close to a whole millimetre measurement such as the 16mm metric bolt above. Use the imperial scale on the vernier calliper to likewise see if the diameter corresponds to an imperial fractional measurement such as $\frac{5}{8}$ or $\frac{3}{4}$ of an inch.



Another way to quickly check the diameter is to use a hole-size gauge such as the one shown. However this is less accurate than the vernier callipers.

**Step four: measure the thread**

With the bolt size identified, the next step is to measure the thread. You should already have worked out if the thread is metric or imperial. The thread gauges above are invaluable for determining thread pitch (metric) or threads per inch (TPI, imperial or Whitworth). Thread gauges are probably the easiest, most foolproof method for determining the thread size and can be used on external and internal threads.



Metric threads are specified by the distance between adjacent threads, which is called pitch (see Figure 1). From the thread tables (pages 139 to 141) we know that an M16 bolt will either have a pitch of 1.5 or 2.0mm. Here we have used the thread gauge to show the pitch is 2.0mm. So, our mystery bolt is an M16x2.0.



If you don't have a thread pitch gauge there are other ways to measure the pitch. It is pretty difficult to measure pitch with a vernier as shown. A far better method is to measure the distance across ten threads then divide the distance by ten.



Here we have a measure of 20mm between ten threads, so by dividing by ten the pitch is 2.0mm.



A tap and die set can be used as a set of thread gauges to match the pitch or TPI of metric or imperial threads.



Match the bolt threads to the thread tap as shown. If the tap is in good condition you should be able to read the pitch straight off the shank of the tap.



For Imperial threads the thread size is expressed as the number of threads per inch. Here we have used the thread gauge to measure 13 threads per inch on this $\frac{1}{2}$ inch bolt.



Alternatively, count the number of threads in an inch using the vernier calliper to accurately measure one inch.



Whitworth threads can really upset the apple cart. They often have the same TPI as UNC threads (see thread tables), but use a different thread angle of 55 degrees, whereas UNC and UNF use 60 degrees. While many will be found to be interchangeable they may feel loose or tight in the threads due to the difference in angles. One size that will invariably trip you up is $\frac{1}{2}$ inch UNC and BSW. They look very similar, but the $\frac{1}{2}$ " UNC thread (left) has 13TPI and the $\frac{1}{2}$ " BSW has 12TPI (right).





A thread chart attached to the wall in the workshop is a pretty handy addition because it provides a quick reference when trying to determine your mystery thread.



A set of metric and imperial thread files can also be used as a makeshift thread gauge, as well as repairing or cleaning damaged threads. The only drawback is they only have eight thread sizes per file. They cost \$30-\$50 depending on quality.



Thread files can measure and clean internal threads as shown, although some files are not equipped with an internal section on the end.



Thread tables

Metric coarse			
thread (tap) size (mm)	pitch (mm)	tapping drill size (mm)	clearance drill size (mm)
2.00	0.40	1.60	2.05
2.50	0.45	2.05	2.60
3.00	0.50	2.50	3.10
3.50	0.60	2.90	3.60
4.00	0.70	3.30	4.10
4.50	0.75	3.70	4.60
5.00	0.80	4.20	5.10
6.00	1.00	5.00	6.10
8.00	1.25	6.80	8.20
10.00	1.50	8.50	10.20
12.00	1.75	10.20	12.20
14.00	2.00	12.00	14.25
16.00	2.00	14.00	16.25
18.00	2.50	15.50	18.25
20.00	2.50	17.50	20.25
22.00	2.50	19.50	22.25
24.00	3.00	21.00	24.25
27.00	3.00	24.00	27.25
30.00	3.50	26.50	30.50
33.00	3.50	29.50	33.50
36.00	4.00	32.00	36.50
42.00	4.50	37.50	42.50
45.00	4.50	4.50	45.50
48.00	5.00	43.00	48.75
52.00	5.00	47.00	52.75

Metric fine			
thread (tap) size (mm)	pitch (mm)	tapping drill size (mm)	clearance drill size (mm)
8.00	1.00	7.00	8.20
10.00	1.25	8.90	10.20
12.00	1.50	10.50	12.20
14.00	1.50	12.50	14.25
16.00	1.50	14.50	16.25
18.00	1.50	16.50	18.25
20.00	1.50	18.50	20.25
22.00	1.50	20.50	22.25
24.00	2.00	22.00	24.25
30.00	2.00	28.00	30.50
36.00	3.00	32.75	36.50
42.00	3.00	38.75	42.50
48.00	3.00	44.75	48.74
56.00	4.00	51.75	57.00
64.00	4.00	59.75	65.50





UNC - Unified National Coarse					
thread (tap) size	Threads (per inch)	Tapping size (mm)	clearance drill size (mm)	Tapping size (inch)	Clearance (inch)
1	64	1.55	1.95	0.061	0.077
2	56	1.85	2.30	0.073	0.091
3	48	2.10	2.65	0.083	0.104
4	40	2.35	2.95	0.093	0.116
5	40	2.65	3.30	0.104	0.130
6	32	2.85	3.60	0.112	0.142
8	32	3.50	4.30	0.138	0.169
10	24	3.90	4.90	0.154	0.193
12	24	4.50	5.60	0.177	0.220
1/4	20	5.10	6.50	0.201	0.256
5/16	18	6.60	8.10	0.260	0.319
3/8	16	8.00	9.70	0.315	0.382
7/16	14	9.40	11.30	0.370	0.445
1/2	13	10.80	13.00	0.425	0.512
9/16	12	12.20	14.50	0.480	0.571
5/8	11	13.50	16.25	0.531	0.640
3/4	10	16.50	19.25	0.650	0.758
7/8	9	19.50	22.50	0.768	0.886
1	8	22.25	25.75	0.876	1.014
1 1/8	7	25.00	29.00	0.984	1.142
1 1/4	7	28.00	32.00	1.102	1.260
1 3/8	6	30.75	35.50	1.211	1.398
1 1/2	6	34.00	38.50	1.339	1.516
1 3/4	5	39.50	45.00	1.555	1.772
2	4.5	45.00	51.00	1.772	2.008

UNF - Unified National Fine					
thread (tap) size	Threads (per inch)	Tapping size (mm)	clearance drill size (mm)	Tapping size (inch)	Clearance (inch)
0	80	1.25	1.60	0.049	0.063
1	72	1.55	1.95	0.061	0.077
2	64	1.90	2.30	0.075	0.091
3	56	2.15	2.65	0.085	0.104
4	48	2.40	2.95	0.094	0.116
5	44	2.70	3.30	0.106	0.130
6	40	2.95	3.60	0.116	0.142
8	36	3.50	4.30	0.138	0.169
10	32	4.10	4.90	0.161	0.193
12	28	4.70	5.60	0.185	0.220
1/4	28	5.50	6.50	0.217	0.256
5/16	24	6.90	8.10	0.272	0.319
3/8	24	8.50	9.70	0.335	0.382
7/16	20	9.90	11.30	0.390	0.445
1/2	20	11.50	13.00	0.453	0.512
9/16	18	12.90	14.50	0.508	0.571
5/8	18	14.50	16.25	0.571	0.640
3/4	16	17.50	19.25	0.689	0.758
7/8	14	20.40	22.50	0.803	0.886
1	12	23.25	25.75	0.915	1.014
1 1/8	12	26.50	29.00	1.043	1.142
1 1/4	12	29.50	32.00	1.161	1.260
1 3/8	12	32.75	35.50	1.289	1.398
1 1/2	12	36.00	38.50	1.417	1.516



BSW - British Standard Whitworth

thread (tap) size (mm)	Threads (per inch)	Tapping size (mm)	clearance drill size (mm)	Tapping size (inch)	Clearance (inch)
1/16	60	1.18	1.65	0.046	0.065
3/32	48	1.87	2.50	0.074	0.098
1/8	40	2.57	3.30	0.101	0.130
5/32	32	3.21	4.10	0.126	0.161
3/16	24	3.75	4.90	0.147	0.193
7/32	24	4.54	5.70	0.179	0.224
1/4	20	5.13	6.50	0.202	0.256
5/16	18	6.58	8.10	0.259	0.319
3/8	16	8.00	9.70	0.315	0.382
7/16	14	9.37	11.30	0.369	0.445
1/2	12	10.67	13.00	0.420	0.512
9/16	12	12.25	14.50	0.482	0.571
5/8	11	13.66	16.25	0.538	0.640
11/16	11	15.24	17.75	0.600	0.699
3/4	10	16.61	19.25	0.654	0.758
13/16	10	18.20	21.00	0.716	0.827
7/8	9	19.51	22.50	0.768	0.886
15/16	9	21.10	24.00	0.831	0.945
1	8	22.35	25.75	0.880	1.014
1 1/8	7	25.09	29.00	0.988	1.142
1 1/4	7	28.26	32.00	1.113	1.260
1 3/8	6	30.86	35.50	1.215	1.398
1 1/2	6	34.03	38.50	1.340	1.516
1 5/8	5	36.40	41.50	1.433	1.634
1 3/4	5	39.57	45.00	1.558	1.772
1 7/8	4.5	42.20	48.00	1.662	1.890
2	4.5	45.38	51.00	1.787	2.008

BA - British Association

thread (tap) size (number)	Threads (per inch)	Tapping size (mm)	clearance drill size (mm)	Tapping size (inch)	Clearance (inch)
0	25.4	5.10	6.10	0.201	0.240
1	28.2	4.49	5.40	0.177	0.213
2	31.3	3.97	4.80	0.156	0.189
3	34.8	3.44	4.20	0.136	0.165
4	38.5	3.00	3.70	0.118	0.146
5	43.1	2.67	3.30	0.105	0.130
6	47.8	2.32	2.90	0.091	0.114
7	52.9	2.07	2.60	0.081	0.102
8	59.2	1.81	2.25	0.071	0.089
9	64.9	1.55	1.95	0.061	0.077
10	72.5	1.38	1.75	0.054	0.069
11	82.0	1.22	1.60	0.048	0.063
12	90.9	1.05	1.40	0.041	0.055
13	102.0	0.97	1.30	0.038	0.051
14	109.9	0.79	1.10	0.031	0.043
15	120.5	0.71	0.98	0.028	0.039
16	133.3	0.62	0.88	0.024	0.035

BSF - British Standard Fine

thread (tap) size (number)	Threads (per inch)	Tapping size (mm)	clearance drill size (mm)	Tapping size (inch)	Clearance (inch)
3/16	32	4.00	4.90	0.157	0.193
7/32	28	4.68	5.70	0.184	0.224
1/4	26	5.41	6.50	0.213	0.256
5/16	22	6.83	8.10	0.269	0.319
3/8	20	8.31	9.70	0.327	0.382
7/16	18	9.76	11.30	0.384	0.445
1/2	16	11.18	13.00	0.440	0.512
9/16	16	12.76	14.50	0.502	0.571
5/8	14	14.13	16.25	0.556	0.640
11/16	14	15.72	17.75	0.619	0.699
3/4	12	17.02	19.25	0.670	0.758
7/8	11	20.01	22.50	0.788	0.886
1	10	22.96	25.75	0.904	1.014
1 1/8	9	25.86	29.00	1.018	1.142
1 1/4	9	29.04	32.00	1.143	1.260
1 3/8	8	31.88	35.50	1.255	1.398
1 1/2	8	35.05	38.50	1.380	1.516

