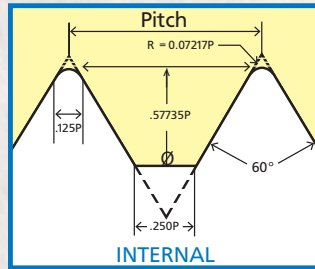
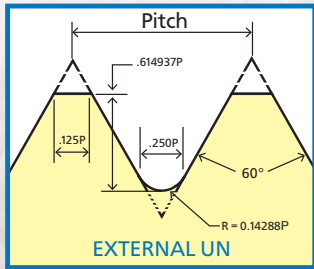


Cutting Conditions

Thread Mill with Straight and Taper Flute

Materials to be Machined	Hardness	Cutting Speed Hard Metal SFM	Cutting Speed Coated SFM	Feed Per Flute Av/d (inch) Cutting Diameter (D1) .4724 - .6299
Unalloyed Steel / Low Alloyed Steel	<600N/mm2	230 - 330	300 - 360	0.002 - 0.004
Unalloyed Steel / Low Alloyed Steel	>600N/mm2	130 - 200	230 - 300	0.002 - 0.003
Lead Alloyed Cutting Steel		230- 330	300 - 360	0.002 - 0.006
High Alloyed / Stainless Steel	400-700N/mm2	130 - 200	230 - 300	0.002 - 0.003
High Alloyed Steel or Cast Iron / Heat Resisting Stainless Steel	700-1500N/mm2	100 - 150	130 - 180	0.002 - 0.003
Special Alloys		50 - 100	80 - 120	0.002 - 0.003
Grey Cast Iron / Nodular Iron Pearlitic	<250HB	230 - 330	300 - 360	0.002 - 0.004
Cast Iron / Nodular Iron Pearlitic	>250HB	130 - 230	230 - 300	0.002 - 0.003
Nodular Ferritic Cast Iron / Malleable Cast Iron		230 - 330	300 - 360	0.002 - 0.004
Titanium, Titanium Alloy		100 - 150	130 - 200	0.002 - 0.003
Copper Alloy (Brass , Bronze)		460 - 530	660 - 720	0.002 - 0.006
Copper Alloy / Aluminum Bronze	(CuAlFe)	400 - 460	560 - 620	0.002 - 0.003
Aluminum Alloy / Magnesium Alloy		590 - 720	750 - 890	0.002 - 0.006
Aluminum Cast	Si<8%	790 - 850	980 - 1120	0.002 - 0.006
Aluminum Cast	Si>8%	460 - 530	690 - 750	0.002 - 0.006
Plastic		790 - 850	980 - 1120	0.003 - 0.009

UN Specifications



UN Thread Specifications

Decimal Thread Pitch:	1 ÷ Threads Per Inch
Theoretical Thread Height:	0.866025 x Decimal Pitch
*External Thread Height:	0.614937 x Decimal Pitch
*Internal Thread Height:	0.577350 x Decimal Pitch
External Crest Radius:	0.108253 x Decimal Pitch
Internal Crest Flat Width:	0.250 x Decimal Pitch
External Max. Root Radius:	0.142881 x Decimal Pitch
Internal Max. Root Radius:	0.072169 x Decimal Pitch

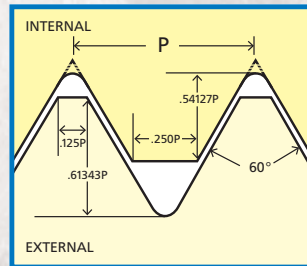
* External & Internal thread height based on maximum material condition full root radius and crest flat truncation as shown in the drawing above.

UN Thread Specifications

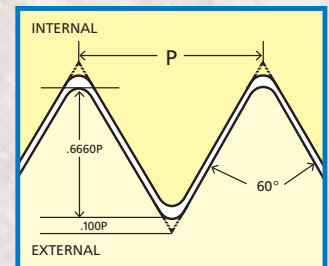
TPI	Internal Thread			External Thread		
	Dec. Pitch	Max Root R	Thd. Height	Max Root R	Crest Flat	Thd. Height
36	0.02778	0.0020	0.0160	0.0040	0.0035	0.0171
32	0.03125	0.0023	0.0180	0.0045	0.0039	0.0192
28	0.03571	0.0026	0.0206	0.0051	0.0045	0.0220
27	0.03704	0.0027	0.0214	0.0053	0.0046	0.0228
24	0.04167	0.0030	0.0241	0.0060	0.0052	0.0256
20	0.05000	0.0036	0.0289	0.0071	0.0063	0.0307
18	0.05556	0.0040	0.0321	0.0079	0.0069	0.0342
16	0.06250	0.0045	0.0361	0.0089	0.0078	0.0384
14	0.07143	0.0052	0.0412	0.0102	0.0089	0.0439
13	0.07692	0.0056	0.0444	0.0110	0.0096	0.0473
12	0.08333	0.0060	0.0481	0.0119	0.0104	0.0512
11	0.09091	0.0066	0.0525	0.0130	0.0114	0.0559
10	0.10000	0.0072	0.0577	0.0143	0.0125	0.0615
9	0.11111	0.0080	0.0642	0.0159	0.0139	0.0683
8	0.12500	0.0090	0.0722	0.0179	0.0156	0.0769
7	0.14286	0.0103	0.0825	0.0204	0.0179	0.0878
6	0.16667	0.0120	0.0962	0.0238	0.0208	0.1025
5	0.20000	0.0144	0.1155	0.0286	0.0250	0.1230
4.5	0.22222	0.0160	0.1283	0.0318	0.0278	0.1367
4	0.25000	0.0180	0.1443	0.0357	0.0313	0.1537

Thread Form Profiles

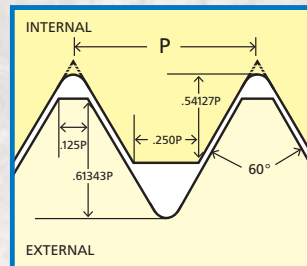
UNIFIED UN



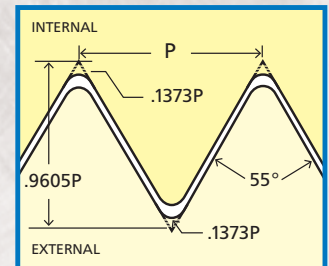
NPSM (MECHANICAL SEAL)



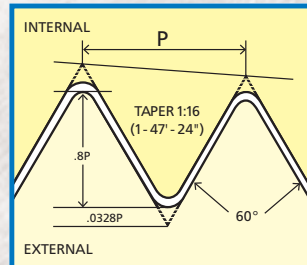
ISO



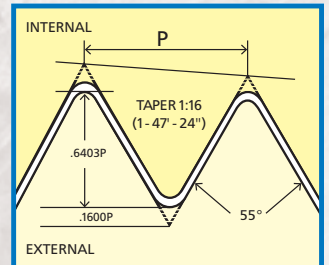
BSP (BRITISH STRAIGHT PIPE)



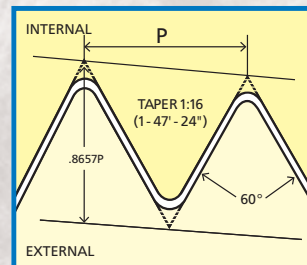
NPT (NATIONAL PIPE TAPER)



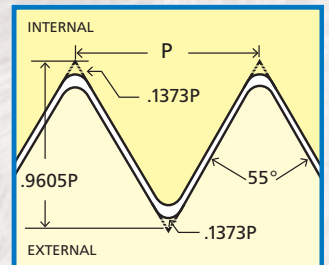
BSPT (BRITISH STANDARD PIPE)



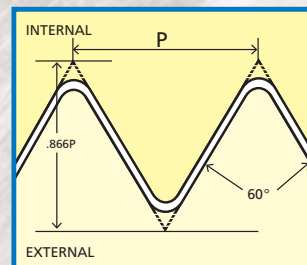
NPTF (DRYSEAL) (NATIONAL PIPE TAPER)



BSW (WHITWORTH)

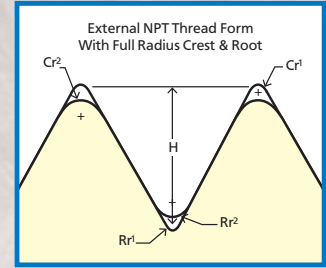
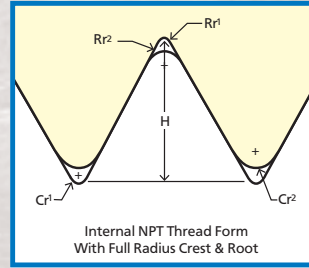


NPSF (DRYSEAL) (NATIONAL PIPE STRAIGHT)

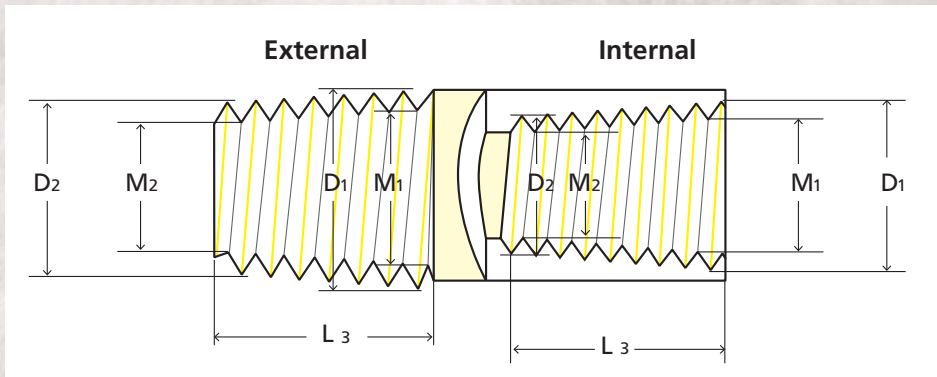


NPT Thread Specifications

NPT Specifications For Radius Crest & Root				
Pitch	Root Radius		Crest Radius	
	Rr1	Rr2	Cr1	Cr2
27 TPI	0.0008	0.0024	0.0012	0.0036
18 TPI	0.0012	0.0033	0.0018	0.0049
14 NPT	0.0016	0.0037	0.0024	0.0056
11.5 TPI	0.0019	0.0042	0.0029	0.0063
8 TPI	0.0027	0.0052	0.0041	0.0078



Nominal thread height shown as H above has been calculated on the mean of the minimum and maximum radius for the following pitch NPT forms: 27 TPI=0.02806", 18 TPI=0.04251", 14 TPI=0.05517", 11.5 TPI=0.06722", 8 TPI=0.09830".



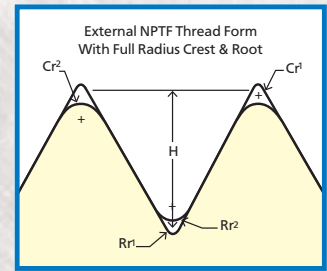
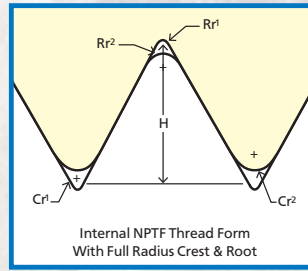
Internal NPSM (National Pipe Straight Mechanical)

Nominal Size	Decimal Ptch	L3 Gage Length	L3 + 1 Pitch*	D1	D2	M1	M2
1/16"- 27	0.03704	0.271	0.3080	0.308	0.292	0.252	0.236
1/8"- 27	0.03704	0.273	0.3100	0.400	0.384	0.344	0.328
1/4"- 18	0.05556	0.395	0.4506	0.533	0.508	0.448	0.424
3/8"- 18	0.05556	0.407	0.4626	0.668	0.643	0.584	0.559
1/2"- 14	0.07143	0.534	0.6054	0.832	0.799	0.723	0.690
3/4"- 14	0.07143	0.553	0.6244	1.043	1.008	0.934	0.899
1"- 11.5	0.08696	0.661	0.7507	1.305	1.263	1.173	1.131
1-1/4"- 11.5	0.08696	0.681	0.7680	1.650	1.607	1.518	1.475
1-1/2"- 11.5	0.08696	0.681	0.7680	1.888	1.846	1.756	1.714
2"- 11.5	0.08696	0.697	0.7840	2.362	2.319	2.230	2.187
2-1/2"- 8	0.1250	1.057	1.1820	2.859	2.793	2.669	2.603
3"- 8	0.1250	1.141	1.2660	3.485	3.414	3.295	3.224
3-1/2"- 8	0.1250	1.250	1.3750	3.985	3.907	3.795	3.717
4"- 8	0.1250	1.300	1.4250	4.484	4.402	4.294	4.212
5"- 8	0.1250	1.406	1.5310	5.546	5.458	5.356	5.268

*L3 + 1 pitch dimension is maximum length of full thread to satisfy standard NPT or NPTF specifications.

NPTF (Dryseal) Thread Specifications

Pitch	Root Radius		Crest Radius	
	Rr1	Rr2	Cr1	Cr2
27 TPI	0.0023	0.00035	0.0017	0.0035
18 TPI	0.0029	0.0041	0.0026	0.0043
14 NPT	0.0029	0.0041	0.0026	0.0043
11.5 TPI	0.0035	0.0052	0.0035	0.0052
8 TPI	0.0046	0.0063	0.0052	0.0069



Nominal thread height shown as H above has been calculated on the mean of the minimum and maximum radius for the following pitch NPT forms: 27 TPI=0.02657", 18 TPI=0.04118", 14 TPI=0.05492", 11.5 TPI=0.06660", 8 TPI=0.09670".

Drill Recommendation For Thread Milling NPT & NPTF Threads

Thread Size	Drill Size	Dec. Diameter
1/16" - 27	B	0.2380
1/8" - 27	21/64"	0.3281
1/4" - 18	27/64"	0.4219
3/8" - 18	9/16"	0.5625
1/2" - 14	17.5 mm	0.6890
3/4" - 14	23 mm	0.9055
1" - 11.5	1-1/8"	1.1250
1-1/4" - 11.5	-	1.4688
1-1/2" - 11.5	-	1.7132
2" - 11.5	-	2.1861
2-1/2" - 8	-	2.6072
3" - 8	-	3.2283
3-1/2" - 8	-	3.7252
4" - 8	-	4.2221

Production of full form internal or external NPT or NPTF threads by thread milling requires changing the minor diameter of the bore or the external major diameter prior to the final thread milling process.

Do not refer to tap drill charts for internal pipe tap applications. The internal minor diameter created using tap drill sizes will truncate the minor diameter crest beyond the maximum allowable limits with the exception of two turns from the end of the pipe.

The chart to the left recommends the ideal drill size for preparing the bore of an internal pipe thread milling application prior to taper reaming or before going straight to the thread milling operation without reaming the taper. This will produce full crest and root form threads to the L3 gage line.

CNC Programming Data For NPT & NPTF Threads

Thread Size	Drill Size
28 & 27	0.0003"
19 & 18	0.0004"
14	0.0006"
11.5 & 11	0.0007"
8	0.0010"

To produce accurate tapered threads for any pipe thread application having a 1: 16 or 3/4" per foot taper, the CNC program must incorporate an increase in arc radius as the centerline of the spindle moves around the internal centerline of the thread to be produced.

For straight threads, a 360° arc move is made around the center with a Z positive move up one pitch. If this were used for pipe threads, the end result would be an oval thread because the 1° - 47' 24" taper ground on the tool cutting edge will move away from the pitch diameter as the tool moves up.

To create a perfect pitch truncated cone pitch diameter for pipe threads, the X & Y arc tool path must also increase to match the taper of 1° - 47' 24" as the tool moves up the bore one pitch. This cannot be performed in one 360° G code line. The use of 4 separate lines using 90° of arc move are required. An ever increasing arc radius is incorporated based on the distance moved up (1/4 pitch) in Z. The end points of each arc move must also include this additional increase in X or Y.

The chart above indicates the exact amount of compensation required for each 90° arc move.

Cutting Conditions

Thread Mill with Straight and Taper Flute				
Materials to be Machined	Hardness	Cutting Speed Hard Metal m/min.	Cutting Speed Coated m/min.	Feed Per Flute Fz (mm) Cutting Diameter (D1) 12,00 - 16,00
Unalloyed Steel / Low Alloyed Steel	<600N/mm2	70 - 100	90 - 110	0,050 - 0,110
Unalloyed Steel / Low Alloyed Steel	>600N/mm2	40 - 60	70 - 90	0,040 - 0,080
Lead Alloyed Cutting Steel		70 - 100	90 - 110	0,060 - 0,160
High Alloyed / Stainless Steel	400-700N/mm2	40 - 60	70 - 90	0,040 - 0,080
High Alloyed Steel or Cast Iron / Heat Resisting Stainless Steel	700-1500N/mm2	30 - 45	40 - 55	0,040 - 0,080
Special Alloys		15 - 30	25 - 35	0,040 - 0,080
Grey Cast Iron / Nodular Iron Pearlitic	<250HB	70 - 100	90 - 110	0,050 - 0,110
Cast Iron / Nodular Iron Pearlitic	>250HB	40 - 70	70 - 90	0,040 - 0,080
Nodular Ferritic Cast Iron / Malleable Cast Iron		70 - 100	90 - 110	0,050 - 0,110
Titanium, Titanium Alloy		30 - 45	40 - 60	0,040 - 0,080
Copper Alloy (Brass , Bronze)		140 - 160	200 - 220	0,060 - 0,160
Copper Alloy / Aluminum Bronze	(CuAlFe)	120 - 140	170 - 190	0,040 - 0,080
Aluminum Alloy / Magnesium Alloy		180 - 220	230 - 270	0,060 - 0,160
Aluminum Cast	Si<8%	240 - 260	300 - 340	0,060 - 0,160
Aluminum Cast	Si>8%	140 - 160	210 - 230	0,060 - 0,160
Plastic		240 - 260	300 - 340	0,080 - 0,240