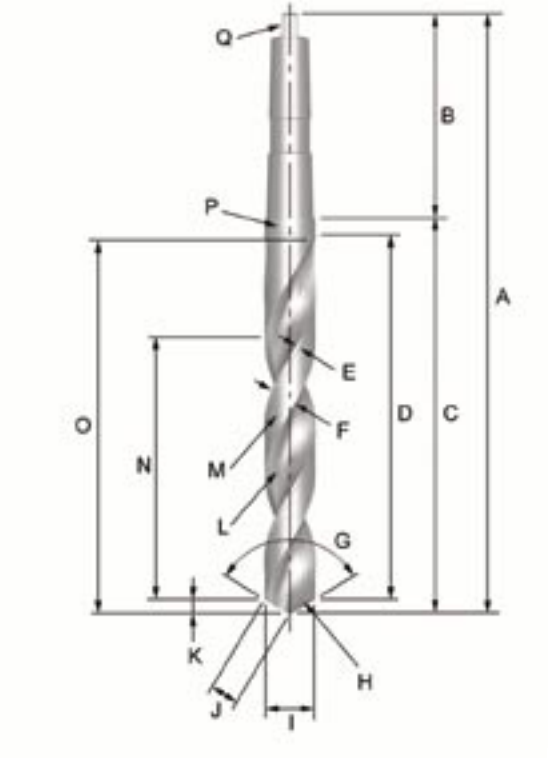
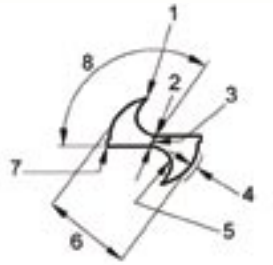
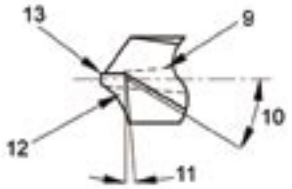
Drilling

Nomenclature



A Overall Length
B Shank
C Body
D Back Tapered Over This Length
E Width of Land
F Width of Fluted Land
G Point Angle
H Major Cutting Edge (Lip)
I Drill Diameter
J Major Cutting Edge (Lip) Length
K Point
L Face
M Body Clearance
N Lead of Helix
O Flute Length
P Silver Ring
Q Tang





1 Heel
2 Web Thickness
3 Chisel Edge
4 Depth of Body Clearance
5 Flute
6 Body Clearance Diameter
7 Outer Corner
8 Chisel Edge Angle

9 Web Taper (shown exaggerated)
10 Axial Rake Angle at Periphery
11 Lip Clearance Angle

12 Flank
13 Chisel Edge Corner

General Hints On Drilling

1. Select the most appropriate drill for the application, bearing in mind the material to be machined, the capability of the machine tool and the coolant to be used.

2. Flexibility within the component and machine tool spindle can cause damage to the drill as well as the component and machine - ensure maximum stability at all times. This can be improved by selecting the shortest possible drill for the application.

3. Tool holding is an important aspect of the drilling operation and the drill cannot be allowed to slip or move in the tool holder.

4. The correct use of Morse Taper Shank drills relies on an efficient fit between the taper surfaces of the tool and the tool holder. The use of a soft-faced hammer should be used to drive the drill into the holder.

5. The use of suitable coolants and lubricants are recommended as required by the particular drilling operation. When using coolants and lubricants, ensure a copious supply, especially at the drill point.

6. Swarf evacuation whilst drilling is essential in ensuring the correct drilling procedure. Never allow the swarf to become stationary in the flute.

7. When regrinding a drill, always makes sure that the correct point geometry is produced and that any wear has been removed.

SELECTION OF DRILL TYPES

Dormer offers an extensive range of standard and special drills with materials and geometry optimised to take into account the cutting behaviour of the workpiece. For example, slow helix drills are better for short chipping materials and quick helix drills are more appropriate for long chipping, ductile alloys.

The following factors have to be taken into consideration when selecting a suitable drill:

- MATERIAL BEING DRILLED
- DEPTH OF HOLE
- MACHINE TOOL CAPABILITY
- COOLANT USED
- CONDITION OF THE MACHINE
- PRODUCTIVITY REQUIREMENTS
- CHOICE OF TOOL HOLDING
- STABILITY OF WORK HOLDING
- HORIZONTAL OR VERTICAL DRILLING
- STATIONARY OR REVOLVING DRILL
- SWARF CONTROL
- HOLE SIZE REQUIREMENTS

Drilling

SELECTION OF DRILLS, FEEDS AND SPEEDS FOR DIFFERENT APPLICATION MATERIALS

The selection of the correct drill and its recommended operating conditions can be found in the Dormer catalogue or Product Selector. Besides the aforementioned considerations, several other factors will dictate a more pertinent selection:

Drill substrate – The materials used for the manufacture of drills could be HSS, HSCo or Solid Carbide. Each material offers certain benefits when drilling certain materials. HSS for example offers high toughness characteristics with relatively low hardness properties. Solid Carbide on the other hand has low impact resistance (Toughness), but very high hardness.

Drill geometry – With the different array of materials to be drilled, comes the need for different drill geometries. Some drills, which are classed as general purpose, will drill a wide range of materials. Application drills however are tools designed with a specific material in mind, i.e. Drills for stainless steel, aluminium or plastics..

Surface Coating – A selection of hard surface coatings are available e.g. Titanium Nitride, Titanium Aluminium Nitride. These are applied to further enhance drill performance, offering different levels of surface hardness, thermal properties and friction coefficient.

The combination of all or some of the above factors has generated a large and comprehensive range of products from which you can choose the most applicable. Ranging from a general purpose HSS drill with standard geometry and no hard surface coating through to a Solid Carbide high performance drill with enhanced geometry and Titanium Aluminium Nitride coating.

Hole Size

As geometric, substrate and coating configurations become more advanced, the ability of a drill to produce a more accurate hole size increases. In general, a standard geometry tool will achieve a hole size to H12. However as the configuration of the drill becomes more complex the achievable hole size, under favourable conditions, can be as good as H8.

To offer a better insight, listed below are the product types and their achievable hole tolerances:

HSS General Purpose drills – H12

HSS / HSCo Parabolic Flute Deep Hole Drills (PFX) – H10

HSS / HSCo High performance TiN/ TiALN coated (ADX) – H9

Solid Carbide High Performance TiN / TiALN coated (CDX) – H8

NOMINAL HOLE DIAMETER (MM)

∅ (mm)	H8	H9	H10	H12
≤ 3	0 / +0.014	0 / +0.025	0 / +0.040	0 / +0.100
> 3 ≤ 6	0 / +0.018	0 / +0.030	0 / +0.048	0 / +0.120
> 6 ≤ 10	0 / +0.022	0 / +0.036	0 / +0.058	0 / +0.150
> 10 ≤ 18	0 / +0.027	0 / +0.043	0 / +0.070	0 / +0.180
> 18 ≤ 30	0 / +0.033	0 / +0.052	0 / +0.084	0 / +0.210

NOMINAL HOLE DIAMETER (INCHES)

∅ (inch)	H8	H9	H10	H12
≤ .1181	0 / +0.0006	0 / +0.0010	0 / +0.0016	0 / +0.0040
>.1181≤.2362	0 / +0.0007	0 / +0.0012	0 / +0.0019	0 / +0.0048
>.2362 ≤.3937	0 / +0.0009	0 / +0.0015	0 / +0.0023	0 / +0.0059
>.3937≤.7087	0 / +0.0011	0 / +0.0017	0 / +0.0028	0 / +0.0071
>.7087≤1.1811	0 / +0.0013	0 / +0.0021	0 / +0.0033	0 / +0.0083

In view of the ability of some drills to produce a much tighter hole tolerance, due consideration should be given to drilled holes which are subject to secondary operations, eg. tapping, reaming. The diameter of the drill will need to be increased from what is recommended to account for the fact that the hole size produced will be smaller.

General Speed And Feed Guide For 2 Diameter Products

When calculating the speed and feed of two diameter drills like centre drills, step drills and subland drills, a compromise is used between the two diameters.
The largest cutting diameter is used to calculate the speed (RPM) and smallest diameter used to establish the feed (mm/rev).

Through Tool Coolant Pressure

The use of through tool coolant is to maintain a copious coolant flow direct to the point of the drill, therefore reducing the amount of heat generated and consequently increasing tool life. High performance drills require an increase in coolant pressure as the coolant flow not only keeps the cutting area cool, it helps with the efficient evacuation of swarf at high penetration rates. In short, the higher the coolant pressure, the more efficient the cooling and swarf evacuation processes are. For high performance and increased productivity, the coolant pressure should be at a minimum 20 bar.

Radial Run Out

Radial run out is measured at the point of the tool whilst held in a collet on the shank. The total indicator reading (TIR) is taken by rotating the tool.
For Solid Carbide Tools, 0.02mm max.
For High Performance HSS Tools, 0.11mm max.
For HSS Jobber Drills, use the algorithm 0.01mm x (Overall Length/Diameter)+0.03mm

Drilling

Flute Form

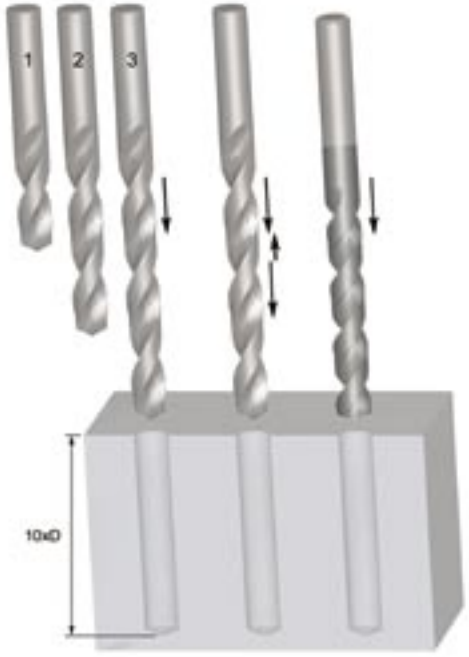
Description	Type of flute	Used for
	Type H - Slow Spiral (10º to 20º Helix Angle)	Application drills for plastic and brass
	Type N - Standard Spiral (21º to 34º Helix Angle)	General purpose drills
	Type W - Quick Spiral (35º to 45º Helix Angle)	Application drills for Stainless Steel and Aluminium. General Purpose High Performance Drills
	CTW - Continuously Thinned Web	Type N flute with integral thinning for the total flute length

Point Type

Description	Type of point
	4 facet point
	National Aerospace standard 907. A recognised standard with the Aerospace Industry
	Point thinned. Used on large diameter drills with a large chisel edge
	PS point is the point geometry of A001 / A002. It is a Dormer designation
	Special point. Again this is a Dormer designation to describe the point geometries of ADX and CDX drills.

Deep Hole Drilling

When drilling deep holes, several methods can be adopted to achieve the depth required. The example below shows four ways of drilling a hole with 10 x the diameter of the drill.



	Series Drilling	Series Drilling	Peck Drilling	Single Pass Drilling
No of drills	3 (2,5xD, 6xD,10xD)	2 (2,5xD,10xD)	1 (10xD)	1 (10xD)
Type of drill	Standard geometry, general purpose	2,5xD ADX or PFX 10xD PFX	Standard geometry, general purpose	PFX geometry and purpose specific tools
+ / -	Expensive Time consuming	More cost effective, quick	Time consuming	Cost effective Fast

Drilling

Standard Length And Flute Length - DIN

	DIN 1897		DIN 338		DIN 340		DIN 1869						DIN 6537				DIN 345	
d_1	l_1	l_2	l_1	l_2	l_1	l_2	l_1	l_2	l_1	l_2	l_1	l_2	l_1	l_2	l_1	l_2	l_1	l_2
mm	mm		mm		mm		mm		mm		mm		mm		mm		mm	
							Series 1		Series 2		Series 3		K		L			
≤ 0,24	19	1,5	19	2,5														
≤ 0,30	19	1,5	19	3														
≤ 0,38	19	2	19	4														
≤ 0,48	19	2,5	20	5														
≤ 0,53	20	3	22	6	32	12												
≤ 0,60	21	3,5	24	7	35	15												
≤ 0,67	22	4	26	8	38	18												
≤ 0,75	23	4,5	28	9	42	21												
≤ 0,85	24	5	30	10	46	25												
≤ 0,95	25	5,5	32	11	51	29												
≤ 1,06	26	6	34	12	56	33												
≤ 1,18	28	7	36	14	60	37												
≤ 1,32	30	8	38	16	65	41												
≤ 1,50	32	9	40	18	70	45												
≤ 1,70	34	10	43	20	75	50	115	75										
≤ 1,90	36	11	46	22	80	53	115	75										
≤ 2,12	38	12	49	24	85	56	125	85	160	110	205	135						
≤ 2,36	40	13	53	27	90	59	135	90	160	110	215	145						
≤ 2,65	43	14	57	30	95	62	140	95	160	110	225	150						
≤ 3,00	46	16	61	33	100	66	150	100	190	130	240	160	62	20	66	28	114	33
≤ 3,20	49	18	65	36	106	69	155	105	200	135	240	170	62	20	66	28	117	36
≤ 3,35	49	18	65	36	106	69	155	105	200	135	240	170	62	20	66	28	120	39
≤ 3,75	52	20	70	39	112	73	165	115	210	145	265	180	62	20	66	28	120	39
≤ 4,25	55	22	75	43	119	78	175	120	220	150	280	190	66	24	74	36	124	43
≤ 4,75	58	24	80	47	126	82	185	125	235	160	295	200	66	24	74	36	128	47
≤ 5,30	62	26	86	52	132	87	195	135	245	170	315	210	66	28	82	44	133	52
≤ 6,00	66	28	93	57	139	91	205	140	260	180	330	225	66	28	82	44	138	57
≤ 6,70	70	31	101	63	148	97	215	150	275	190	350	235	79	34	91	53	144	63
≤ 7,50	74	34	109	69	156	102	225	155	290	200	370	250	79	36	91	53	150	69
≤ 8,50	79	37	117	75	165	109	240	165	305	210	390	265	89	40	103	61	156	75
≤ 9,50	84	40	125	81	175	115	250	175	320	220	410	280	89	40	103	61	162	81

Standard Length And Flute Length - DIN

	DIN 1897		DIN 338		DIN 340		DIN 1869						DIN 6537				DIN 345	
d_1	l_1	l_2	l_1	l_2	l_1	l_2	l_1	l_2	l_1	l_2	l_1	l_2	l_1	l_2	l_1	l_2	l_1	l_2
mm	mm		mm		mm		mm		mm		mm		mm		mm		mm	
							Series 1		Series 2		Series 3		K		L			
≤ 10,60	89	43	133	87	184	121	265	185	340	235	430	295	102	55	118	70	168	87
≤ 11,80	95	47	142	94	195	128	280	195	365	250			102	55	118	70	175	94
≤ 13,20	102	51	151	101	205	134	295	205	375	260			107	60	124	76	182	101
≤ 14,00	107	54	160	108	214	140							107	60	124	76	189	108
≤ 15,00	111	56	169	114	220	144							115	65	133	82	212	114
≤ 16,00	115	58	178	120	227	149							115	65	133	82	218	120
≤ 17,00	119	60	184	125	235	154							123	73	143	91	223	125
≤ 18,00	123	62	191	130	241	158							123	73	143	91	228	130
≤ 19,00	127	64	198	135	247	162							131	79	153	99	233	135
≤ 20,00	131	66	205	140	254	166							131	79	153	99	238	140
≤ 21,20	136	68			261	171											243	145
≤ 22,40	141	70			268	176											248	150
≤ 23,00	141	70			268	176											253	155
≤ 23,60	146	72			275	180											276	155
≤ 25,00	151	75			282	185											281	160
≤ 26,50	156	78			290	190											286	165
≤ 28,00	162	81			298	195											291	170
≤ 30,00	168	84			307	201											296	175
≤ 31,50	174	87			316	207											301	180
≤ 31,75	180	90															306	185
≤ 33,50	180	90															334	185
≤ 35,50	186	93															339	190
≤ 37,50	193	96															344	195
≤ 40,00	200	100															349	200
≤ 42,50	207	104															354	205
≤ 45,00	214	108															359	210
≤ 47,50	221	112															364	215
≤ 50,00	228	116															369	220

Drilling

Standard Length And Flute Length - ANSI

Decimal Inch	Decimal Metric	Screw Machine		Jobber Length		Taper Length		Morse Taper shank	
d_1	d_1	l_1	l_2	l_1	l_2	l_1	l_2	l_1	l_2
		inch	inch	inch	inch	inch	inch	inch	inch
0.0059-0.0079	0.150-0.200			3/4	1/16				
0.0083-0.0100	0.211-0.254			3/4	5/64				
0.0105-0.0130	0.267-0.330			3/4	3/32				
0.0135-0.0145	0.343-0.368			3/4	1/8				
0.0150-0.0157	0.380-0.400			3/4	3/16				
0.0160-0.0200	0.406-0.508			7/8	3/16				
0.0210-0.0225	0.533-0.572			1.	1/4				
0.0236-0.0250	0.600-0.635			1.1/8	5/16				
0.0256-0.0280	0.650-0.711			1.1/4	3/8				
0.0292-0.0330	0.742-0.838			1.3/8	1/2				
0.0335-0.0380	0.850-0.965			1.1/2	5/8				
0.0390-0.420	0.991-1.067	1.3/8	1/2	1.5/8	11/16	2.1/4	1.1/8		
0.0430-0.0469	1.092-1.191	1.3/8	1/2	1.3/4	3/4	2.1/4	1.1/8		
0.0472-0.0625	1.200-1.588	1.5/8	5/8	1.7/8	7/8	3.	1.3/4		
0.0630-0.0635	1.600-1.613	1.11/16	11/16	1.7/8	7/8	3.3/4	2.		
0.0650-0.0781	1.650-1.984	1.11/16	11/16	2.	1.	3.3/4	2.		
0.0785-0.0787	1.994-2.000	1.11/16	11/16	2.	1.	4.1/4	2.1/4		
0.0807-0.0860	2.050-2.184	1.3/4	3/4	2.1/8	1.1/8	4.1/4	2.1/4		
0.0866-0.0938	2.200-2.383	1.3/4	3/4	2.1/4	1.1/4	4.1/4	2.1/4		
0.0945-0.0995	2.400-2.527	1.13/16	13/16	2.3/8	1.3/8	4.5/8	2.1/2		
0.1015-0.1065	2.578-2.705	1.13/16	13/16	2.1/2	1.7/16	4.5/8	2.1/2		
0.1094	2.779	1.13/16	13/16	2.5/8	1.1/2	4.5/8	2.1/2		
0.1100.1130	2.794-2.870	1.7/8	7/8	2.5/8	1.1/2	5.1/8	2.3/4		
0.1142-0.1160	2.900-2.946	1.7/8	7/8	2.3/4	1.5/8	5.1/8	2.3/4		
0.1181-0.1250	3.000-3.175	1.7/8	7/8	2.3/4	1.5/8	5.1/8	2.3/4	5.1/8	1.7/8
0.1260-0.1285	3.200-3.264	1.15/16	15/16	2.3/4	1.5/8	5.3/8	3.	5.3/8	2.1/8
0.1299-0.1406	3.300-3.571	1.15/16	15/16	2.7/8	1.3/4	5.3/8	3	5.3/8	2.1/8
0.1417-0.1496	3.600-3.800	2.1/16	1.	3.	1.7/8	5.3/8	3	5.3/8	2.1/8
0.1520-0.1562	3.861-3.967	2.1/16	1.	3.1/8	2.	5.3/8	3	5.3/8	2.1/8
0.1570	3.988	2.1/8	1.1/16	3.1/8	2.	5.3/4	3.3/8		
0.1575-0.1719	4.000-4.366	2.1/8	1.1/16	3.1/4	2.1/8	5.3/4	3.3/8	5.3/4	2.1/2
0.1730-0.1820	4.394-4.623	2.3/16	1.1/8	3.3/8	2.3/16	5.3/4	3.3/8	5.3/4	2.1/2
0.1850-0.1875	4.700-4.762	2.3/16	1.1/8	3.1/2	2.5/16	5.3/4	3.3/8	5.3/4	2.1/2
0.1890-0.1910	4.800-4.851	2.1/4	1.3/16	3.1/2	2.5/16	6.	3.5/8	6.	2.3/4
0.1929-0.2031	4.900-5.159	2.1/4	1.3/16	3.5/8	2.7/16	6.	3.5/8	6.	2.3/4
0.2040-0.2188	5.182-5.558	2.3/8	1.1/4	3.3/4	2.1/2	6.	3.5/8	6.	2.3/4

For decimal equivalent chart, please see pages 30-31

Standard Length And Flute Length - ANSI

Decimal Inch	Decimal Metric	Screw Machine		Jobber Length		Taper Length		Morse Taper shank	
d_1	d_1	l_1	l_2	l_1	l_2	l_1	l_2	l_1	l_2
		inch	inch	inch	inch	inch	inch	inch	inch
0.2205-0.2344	5.600-5.954	2.7/16	1.5/16	3.7/8	2.5/8	6.1/8	3.3/4	6.1/8	2.7/8
0.2362-0.2500	6.000-6.350	2.1/2	1.3/8	4.	2.3/4	6.1/8	3.3/4	6.1/8	2.7/8
0.2520	6.400	2.5/8	1.7/16	4.1/8	2.7/8	6.1/4	3.7/8		
0.2559-0.2656	6.500-6.746	2.5/8	1.7/16	4.1/8	2.7/8	6.1/4	3.7/8	6.1/4	3.
0.2660-0.2770	6.756-7.036	2.11/16	1.1/2	4.1/8	2.7/8	6.1/4	3.7/8	6.1/4	3.
0.2795-0.2812	7.100-7.142	2.11/16	1.1/2	4.1/4	2.15/16	6.1/4	3.7/8	6.1/4	3.
0.2835-0.2900	7.200-7.366	2.3/4	1.9/16	4.1/4	2.15/16	6.3/8	4.	6.3/8	3.1/8
0.2913-0.2969	7.400-7.541	2.3/4	1.9/16	4.3/8	3.1/16	6.3/8	4.	6.3/8	3.1/8
0.2992-0.3020	7.600-7.671	2.13/16	1.5/8	4.3/8	3.1/16			6.3/8	3.1/8
0.3031-0.3125	7.700-7.938	2.13/16	1.5/8	4.1/2	3.3/16	6.3/8	4.	6.3/8	3.1/8
0.3150-0.3160	8.000-8.026	2.15/16	1.11/16	4.1/2	3.3/16	6.1/2	4.1/8	6.1/2	3.1/4
0.3189-.03281	8.100-8.334	2.15/16	1.11/16	4.5/8	3.5/16	6.1/2	4.1/8	6.1/2	3.1/4
0.3307-0.3438	8.400-8.733	3.	1.11/16	4.3/4	3.7/16	6.1/2	4.1/8	6.1/2	3.1/4
0.3465-0.3594	8.800-9.129	3.1/16	1.3/4	4.7/8	3.1/2	6.3/4	4.1/4	6.3/4	3.1/2
0.3622-0.3750	9.200-9.525	3.1/8	1.13/16	5.	3.5/8	6.3/4	4.1/4	6.3/4	3.1/2
03770-0.3906	9.576-9.921	3.1/4	1.7/8	5.1/8	3.3/4	7.	4.3/8	7.	3.5/8
0.3937-0.3970	10.000-10.084	3.5/16	1.15/16	5.1/8	3.3/4	7.	4.3/8	7.	3.5/8
0.4016-0.4062	10.200-10.320	3.5/16	1.15/16	5.1/4	3.7/8	7.	4.3/8	7.	3.5/8
0.4130-0.4134	10.490-10.500	3.3/8	2.	5.1/4	3.7/8	7.1/4	4.5/8	7.1/4	3.7/8
0.4219	10.716	3.3/8	2.	5.3/8	3.15/16	7.1/4	4.5/8	7.1/4	3.7/8
0.4252-0.4375	10.800-11.112	3.7/16	2.1/16	5.1/2	4.1/16	7.1/4	4.5/8	7.1/4	3.7/8
0.4409-0.4531	11.200-11.509	3.9/16	2.1/8	5.5/8	4.3/16	7.1/2	4.3/4	7.1/2	4.1/8
0.4646-0.4688	11.800-11.908	3.5/8	2.1/8	5.3/4	4.5/16	7.1/2	4.3/4	7.1/2	4.1/8
0.4724-0.4844	12.000-12.304	3.11/16	2.3/16	5.7/8	4.3/8	7.3/4	4.3/4	8.1/4	4.3/8
0.4921-0.5000	12.500-12.700	3.3/4	2.1/4	6.	4.1/2	7.3/4	4.3/4	8.1/4	4.3/8
0.5039-0.5118	12.800-13.000	3.7/8	2.3/8	6.	4.1/2			8.1/2	4.5/8
0.5156-0.5315	13.096-13.500	3.7/8	2.3/8	6.5/8	4.13/16			8.1/2	4.5/8
0.5433-0.5781	13.800-14.684	4.1/8	2.5/8	6.5/8	4.13/16			8.3/4	4.7/8
0.5807-0.5938	14.750-15.083	4.1/8	2.5/8	7.1/8	5.3/16			8.3/4	4.7/8
0.6004-0.6250	15.250-15.875	4.1/4	2.3/4	7.1/8	5.3/16			8.3/4	4.7/8
0.6299-0.6562	16.000-16.669	4.1/2	2.7/8	7.1/8	5.3/16			9.	5.1/8
0.6594-0.6875	16.750-17.462	4.1/2	2.7/8	7.5/8	5.5/8			9.1/4	5.3/8
0.6890	17.500	4.3/4	3.	7.5/8	5.5/8			9.1/2	5.5/8
0.7031-0.7188	17.859-18.258	4.3/4	3.					9.1/2	5.5/8
0.7283-0.7500	18.500-19.050	5.	3.1/8					9.3/4	5.7/8
0.7656-0.7812	19.446-19.845	5.1/8	3.1/4					9.7/8	6.
0.7879-0.8125	20.000-20.638	5.1/4	3.3/8					10.3/4	6.1/8

For decimal equivalent chart, please see pages 30-31

Drilling

Standard Length And Flute Length - ANSI

Decimal Inch	Decimal Metric	Screw Machine		Jobber Length		Taper Length		Morse Taper shank	
d_1	d_1	l_1	l_2	l_1	l_2	l_1	l_2	l_1	l_2
		inch	inch	inch	inch	inch	inch	inch	inch
0.8268-0.8750	21.000-22.225	5.3/8	3.1/2					10.3/4	6.1/8
0.8858-0.9062	22.500-23.017	5.5/8	3.5/8					10.3/4	6.1/8
0.9219-0.9375	23.416-23.812	5.3/4	3.3/4					10.3/4	6.1/8
0.9449-0.9688	24.000-24.608	5.7/8	3.7/8					11.	6.3/8
0.9843-1.000	25.000-25.400	6.	4.					11.	6.3/8
1.0039-1.0312	25.500-26.192							11.1/8	6.1/2
1.0433-1.0630	26.500-27.000							11.1/4	6.5/8
1.0781-1.0938	27.384-27.783							12.1/2	6.7/8
1.1024-1.1250	28.000-28.575							12.3/4	7.1/8
1.1406-1.562	28.971-29.367							12.7/8	7.1/4
1.1614-1.1875	29.500-30.162							13.	7.3/8
1.2008-1.2188	30.500-30.958							13.1/8	7.1/2
1.2205-1.2500	31.000-31.750							13.1/2	7.7/8
1.2598-1.2812	32.000-32.542							14.1/8	8.1/2
1.2969-1.3125	32.941-33.338							14.1/4	8.5/8
1.3189-1.3438	33.500-34.133							14.3/8	8.3/4
1.3583-1.3750	34.500-34.925							14.1/2	8.7/8
1.3780-1.4062	35.000-35.717							14.5/8	9.
1.4173-1.4375	36.000-36.512							14.3/4	9.1/8
1.4531-1.4688	36.909-37.308							14.7/8	9.1/4
1.4764-1.5000	37.500-38.100							15.	9.3/8
1.5312	38.892							16.3/8	9.3/8
1.5354-1.5625	39.000-39.688							16.5/8	9.5/8
1.5748-1.5938	40.000-40.483							16.7/8	9.7/8
1.6094-1.6250	40.879-41.275							17.	10.
1.6406-1.8438	41.671-46.833							17.1/8	10.1/8
1.8504-2.0312	47.000-51.592							17.3/8	10.3/8
2.0472-2.1875	52.000-55.563							17.3/8	10.1/4
2.2000-2.3750	56.000-60.325							17.3/8	10.1/8
2.4016-2.500	61.000-63.500							18.3/4	11.1/4
2.5197-2.6250	64.000-66.675							19.1/2	11.7/8
2.6378-2.7500	67.000-69.850							20.3/8	12.3/4
2.7559-2.8125	70.000-71.438							21.1/8	13.3/8

For decimal equivalent chart, please see pages 30-31

Trouble Shooting When Drilling

Problem	Cause	Remedy
Broken or twisted tangs	Bad fit between shank and socket	Ensure the shank and socket are clean and free from damage
Splitting of the web	Feed too high	Reduce feed to optimum rate
	Insufficient initial clearance	Regrind to correct specification
	Excessive web thinning	Regrind to correct specification
	Heavy impact at point of drill	Avoid impact at the point of drill. Take care with taper shank drills when inserting / ejecting them from a spindle
Worn outer corners	Excessive speed	Reduce speed to optimum - may be able to increase feed
Broken outer corners	Unstable component set up	Reduce movement in the component
Chipped cutting lips	Excessive initial clearance	Regrind to correct specification
Breakage at flute run out	Choking of flutes	Adopt a peck / series drilling concept
	Drill slipping	Ensure the drill is held securely in the chuck and spindle
Spiral finish in hole	Insufficient feed	Increase feed
	Bad positional accuracy	Use a spot drill before drilling
Hole size too large	Incorrect point geometry	Check point geometry in regrinding section
	Ineffective swarf clearance	Adjust speed, feed and peck length to achieve more manageable swarf