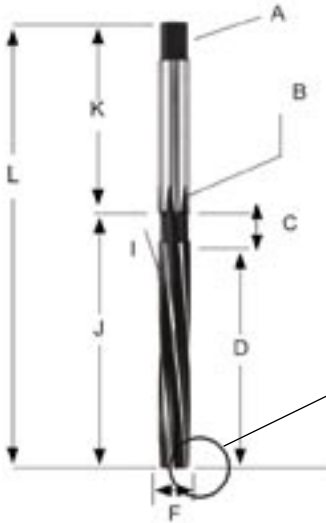
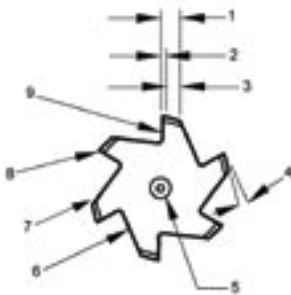


# Reaming

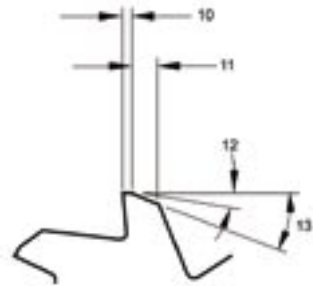
## NOMENCLATURE



- A Tang
- B Recess
- C Recess Length
- D Cut Length
- E Bevel Lead Length
- F Diameter
- G Bevel Lead
- H Bevel Lead Angle
- I Helix Angle
- J Body Length
- K Shank Length
- L Overall Length



- 1 Width of Land
- 2 Circular Land
- 3 Clearance
- 4 Clearance Angle
- 5 Centre Hole
- 6 Flute
- 7 Heel
- 8 Cutting Edge
- 9 Face



- 10 Width of Primary Clearance
- 11 Width of Secondary Clearance
- 12 Primary Clearance Angle
- 13 Secondary Clearance Angle

## GENERAL HINTS ON REAMING

To obtain the best results when using reamers it is essential to make them 'work'. It is a common fault to prepare holes for reaming with too little stock left in. If insufficient stock is left in the hole before reaming, then the reamer will rub, quickly show wear and will result in loss of diameter. It is equally important for performance not to leave too much stock in the hole. (See Stock Removal on next page).

1. Select the optimum type of reamer and the optimum speeds and feeds for the application. Ensure that pre-drilled holes are the correct diameter.
2. The workpiece must be held rigid and the machine spindle should have no play.
3. The chuck in which a straight shank reamer is held must be good quality. If the reamer slips in the chuck and the feed is automatic, breakage of the reamer may occur.
4. When driving a Morse Taper Shank reamer into a socket, sleeve or machine spindle, always use a soft faced hammer. Make sure there is a good fit between the reamer shank and the sleeve or socket otherwise misalignment will occur and the reamer may cut oversize.
5. Keep tool overhang from machine spindle to a minimum.
6. Use recommended lubricants to enhance the life of the reamer and ensure the fluid reaches the cutting edges. As reaming is not a heavy cutting operation, soluble oil 40:1 dilution is normally satisfactory. Air blasting may be used with grey cast iron, if dry machining.
7. Do not allow the flutes of a reamer to become blocked with swarf.
8. Before the reamer is reground, check concentricity between centres. In most instances only the bevel lead will need regrinding.
9. Keep reamers sharp. Frequent regrinding is good economy, but it is important to understand that reamers cut only on the bevel and taper leads and not on the lands. Consequently only these leads need regrinding. Accuracy of regrinding is important to hole quality and tool life.

## HAND / MACHINE REAMERS

Although both hand and machine reamers offer the same capability regarding finished hole size, the use of each must be considered according to application. A hand reamer, for reasons of alignment, has a long taper lead, whereas a machine reamer has only a 45 degree bevel lead. A machine reamer cuts only on the bevel lead, a hand reamer cuts on the bevel lead and also on the taper lead.

# Reaming

## APPLICATION REAMERS

As with most cutting tools, the substrate and geometric configuration of reamers differs, dependent on the material they are intended to cut. As such, care should be taken to ensure that the correct choice of reamer is made.

NC reamers are manufactured with a shank tolerance of h6. This enables the reamer to be used in hydraulic and heat shrink tool holding systems, offering enhanced accuracy and concentricity.

## ADJUSTABLE REAMERS

Several types of adjustable reamers are available, all offering varying degrees of diameter adjustment. It is an important aspect of adjustable reamers to follow this set procedure:

- Adjust the reamer to the required diameter.
- Check the reamer between centres for concentricity and lip height variation.
- If required, grind the reamer to eliminate any eccentricity or lip height variation.
- Re-check the diameter.

## STOCK REMOVAL

The recommended stock removal in reaming is dependent on the application material and the surface finish of the pre-drilled hole. General guidelines for stock removal are shown in the following tables:

Size of reamed hole (mm)	When pre-drilled	When pre-core-drilled	Size of reamed hole (inches)	When pre-drilled	When pre-core-drilled
Below 4	0.1	0.1	Below 3/16	0.004	0.004
Over 4 to 11	0.2	0.15	3/16 to 1/2	0.008	0.006
Over 11 to 39	0.3	0.2	1/2 to 1. 1/2	0.010	0.008
Over 39 to 50	0.4	0.3	1. 1/2 to 2	0.016	0.010

## SELECTION OF REAMER TYPES

Reaming is a recognised method of producing dimensionally accurate holes of fine surface finish. Dormer offers a range of reamers for producing holes to H7 tolerance.

Reamers are classified into various types:

- Solid - available in two shank types, Straight (cylindrical) and Morse Taper.
- Shell - for use on arbors.
- Expanding - with adjustable HSS blades and used for light work.

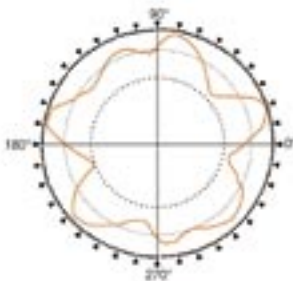
The most common types of reamers have a left-hand spiral because the main applications involve through holes requiring chips to be pushed forward. For blind holes, reamers with straight flutes or right hand spirals are recommended.

The most efficient reaming conditions depend on the application, material, quality of hole required, stock removal, lubrication and other factors. A general guide to surface speeds and feeds for machine reamers is shown in the reamer AMG and feed charts (see Dormer catalogue or Product Selector) and stock removal tables.

Extremely unequal spacing on reamers means that the divide is not the same for each tooth. As there are no two teeth diametrically opposite each other, the reamer produces a hole with a roundness variance of between 1 and 2  $\mu\text{m}$ . This compared with a variance of up to 10 $\mu\text{m}$  with unequal spacing.

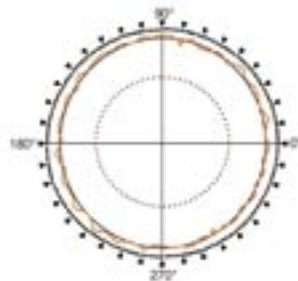
## CARBIDE REAMERS - COMPARISON SPACING / EU SPACING

unequal spacing  
roundness error up to 10  $\mu\text{m}$



Results of roundness

extremely unequal spacing  
roundness error up to 1 - 2  $\mu\text{m}$



Results of roundness

# Reaming

## TOLERANCE LIMITS



### 1. ON THE CUTTING DIAMETER OF STANDARD REAMERS

The diameter ( $d_1$ ) is measured across the circular land immediately behind the bevel or taper lead. The tolerance is in accordance with DIN 1420 and is intended to produce H7 holes.

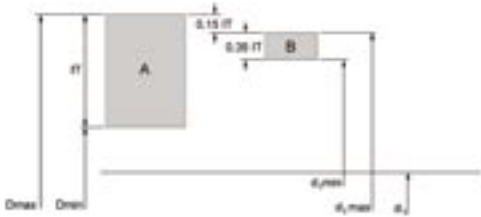
REAMER TOLERANCE			
Diameter (mm)		Tolerance Limit (mm)	
Over	Up to and including	High +	Low +
	3	0.008	0.004
3	6	0.010	0.005
6	10	0.012	0.006
10	18	0.015	0.008
18	30	0.017	0.009
30	50	0.021	0.012
50	80	0.025	0.014

### 2. ON A H7 HOLE

The most common tolerance on a finished hole is H7 (see table below). For any other tolerance the figure and table beneath point 3 can be used to calculate the reamers tolerance location and width.

HOLE TOLERANCE			
Diameter (mm)		Tolerance Limit (mm)	
Over	Up to and including	High +	Low +
	3	0.010	0
3	6	0.012	0
6	10	0.015	0
10	18	0.018	0
18	30	0.021	0
30	50	0.025	0
50	80	0.030	0

3. When it is necessary to define the dimensions of a special reamer intended to cut to a specific tolerance, e.g. D8, this well proven guide can be used.



A = Hole Tolerance  
 B = Reamer Tolerance  
 IT = Tolerance Width  
 Dmax = Max Diameter of Hole  
 Dmin = Min Diameter of Hole  
 $d_{1,nom}$  = Nominal Diameter  
 $d_{1,max}$  = Max Diameter of Reamer  
 $d_{1,min}$  = Min Diameter of Reamer

Tolerance width	Diameter Tolerance Width							
	over 1 incl. 3	over 3 incl. 6	over 6 incl. 10	over 10 incl. 18	over 18 incl. 30	over 30 incl. 50	over 50 incl. 80	over 80 incl. 120
IT 5	4	5	6	8	9	11	13	15
IT 6	6	8	9	11	13	16	19	22
IT 7	10	12	15	18	21	25	30	35
IT 8	14	18	22	27	33	39	46	54
IT 9	25	30	36	43	52	62	74	87
IT 10	40	48	58	70	84	100	120	140
IT 11	60	75	90	110	130	160	190	220
IT 12	100	120	150	180	210	250	300	350

### Example of a 10mm hole with tolerance D8

Maximum diameter of hole = 10.062  
 Minimum diameter of hole = 10.040  
 Hole tolerance (IT8) = 0.022

The maximum limit for the reamer is the maximum limit of the hole size reduced by 0.15 times the tolerance for the hole. The value is rounded up to the next higher multiple of 0.001mm

$$0.15 \times \text{hole tolerance (IT8)} = 0.0033, \text{ rounded up} = 0.004$$

The minimum limit for the reamer is the maximum limit of the reamer reduced by 0.35 times the tolerance for the hole. The value is rounded up to the next higher multiple 0.001mm.

$$0.35 \times \text{hole tolerance (IT8)} = 0.0077, \text{ rounded up} = 0.008$$

Maximum limit for reamer = 10.062 - 0.004 = 10.058  
 Minimum limit for reamer = 10.058 - 0.008 = 10.050

# Reaming

## SELECTION TABLE FOR 0.01MM INCREMENT REAMERS

Example:

Required Fit:

d = 4,25mm F8

Selection:

Basic Diameter + Table Value for F8 = 1/100 reamer

4,25 + 0,02 = 4,27mm

Tool Required:

4,27mm Diameter Reamer

	A 9	A 11	B 8	B 9	B 10	B 11	C 8	C 9	C 10	C 11	D 7	D 8	D 9	D 10	D 11
<b>1 - 3</b>	-	+ 0,31	-	-	+ 0,17	+ 0,18	-	-	+ 0,09	+ 0,10	-	-	-	+ 0,05	+ 0,06
<b>3 - 6</b>	+ 0,29	+ 0,32	+ 0,15	+ 0,16	+ 0,17	+ 0,19	+ 0,08	+ 0,09	+ 0,10	+ 0,12	-	+ 0,04	+ 0,05	+ 0,06	+ 0,08
<b>6 - 10</b>	+ 0,30	+ 0,35	+ 0,16	+ 0,17	+ 0,19	+ 0,22	+ 0,09	+ 0,10	+ 0,12	+ 0,15	-	+ 0,05	+ 0,06	+ 0,08	+ 0,11
<b>10 - 18</b>	+ 0,32	+ 0,37	-	+ 0,18	+ 0,20	+ 0,23	+ 0,11	+ 0,12	+ 0,14	+ 0,18	+ 0,06	+ 0,06	+ 0,08	+ 0,10	+ 0,13
	<b>E 7</b>	<b>E 8</b>	<b>E 9</b>	<b>F 7</b>	<b>F 8</b>	<b>F 9</b>	<b>F 10</b>	<b>G 6</b>	<b>G 7</b>	<b>H 6</b>	<b>H 7</b>	<b>H 8</b>	<b>H 9</b>	<b>H 10</b>	<b>H 11</b>
<b>1 - 3</b>	-	+ 0,02	+ 0,03	+ 0,01	-	+ 0,02	-	-	-	-	-	-	-	+ 0,03	+ 0,04
<b>3 - 6</b>	-	+ 0,03	+ 0,04	-	+ 0,02	+ 0,03	+ 0,04	-	+ 0,01	-	-	+ 0,01	+ 0,02	+ 0,03	+ 0,05
<b>6 - 10</b>	-	-	+ 0,05	+ 0,02	-	+ 0,03	+ 0,05	-	-	-	-	+ 0,01	+ 0,02	+ 0,04	+ 0,07
<b>10 - 18</b>	+ 0,04	-	+ 0,06	-	+ 0,03	+ 0,04	+ 0,07	-	-	-	+ 0,01	-	+ 0,03	+ 0,05	+ 0,08
	<b>H 12</b>	<b>H 13</b>	<b>J 6</b>	<b>J 7</b>	<b>J 8</b>	<b>JS 6</b>	<b>JS 7</b>	<b>JS 8</b>	<b>JS 9</b>	<b>K 7</b>	<b>K 8</b>	<b>M 6</b>	<b>M 7</b>	<b>M 8</b>	<b>N 6</b>
<b>1 - 3</b>	+ 0,08	+ 0,11	-	-	-	-	-	+ 0,00	+ 0,00	-	-	-	-	-	-
<b>3 - 6</b>	+ 0,09	+ 0,14	-	+ 0,00	+ 0,00	-	+ 0,00	+ 0,00	+ 0,00	-	-	-	-	-	-
<b>6 - 10</b>	+ 0,12	+ 0,18	-	+ 0,00	+ 0,00	-	+ 0,00	+ 0,00	+ 0,00	-	-	-	-	- 0,01	-
<b>10 - 18</b>	+ 0,14	+ 0,22	-	+ 0,00	+ 0,00	-	+ 0,00	+ 0,00	+ 0,01	-	-	- 0,01	- 0,01	- 0,01	-
	<b>N 7</b>	<b>N 8</b>	<b>N 9</b>	<b>N 10</b>	<b>N 11</b>	<b>P 6</b>	<b>P 7</b>	<b>R 6</b>	<b>R 7</b>	<b>S 6</b>	<b>S 7</b>	<b>U 6</b>	<b>U 7</b>	<b>U 10</b>	<b>Z 10</b>
<b>1 - 3</b>	- 0,01	-	-	- 0,02	- 0,02	-	-	-	-	-	- 0,02	-	-	-	- 0,04
<b>3 - 6</b>	- 0,01	- 0,01	- 0,01	- 0,02	- 0,02	-	-	-	-	-	-	-	-	- 0,04	- 0,05
<b>6 - 10</b>	-	-	-	- 0,02	- 0,02	-	-	-	-	-	-	-	- 0,03	- 0,05	- 0,06
<b>10 - 18</b>	-	-	- 0,02	- 0,02	- 0,03	-	- 0,02	-	-	-	- 0,03	-	-	- 0,05	- 0,07

### Notes for use with the above table

This table is formulated to allow the selection of reamers with diameters in 0,01mm increments.

The values given take into consideration the the basic manufacturing tolerances as standard. These are:

Up to Diameter 5,50mm + 0,004 / 0

Over 5.50mm + 0,005 / 0

All tolerances in blue are achievable with 0,01mm increment reamers as they correspond to the manufacturing tolerances for reamers according to DIN 1420.

## STANDARD LENGTH AND FLUTE LENGTH



$d_1$	DIN 9		DIN 206		DIN 208		DIN 212		DIN 311		DIN 859		DIN 1895		DIN 2180	
	$l_1$	$l_2$	$l_1$	$l_2$	$l_1$	$l_2$	$l_1$	$l_2$	$l_1$	$l_2$	$l_1$	$l_2$	$l_1$	$l_2$	$l_1$	$l_2$
mm	mm		mm		mm		mm		mm		mm		mm		mm	
≤ 0,24																
≤ 0,30																
≤ 0,38																
≤ 0,48																
≤ 0,53																
≤ 0,60	38	20														
≤ 0,67																
≤ 0,75																
≤ 0,85	42	24														
≤ 0,95																
≤ 1,06	46	28														
≤ 1,18																
≤ 1,32	50	32					34	5.5								
≤ 1,50	57	37	41	20			40	8								
≤ 1,70			44	21			43	9								
≤ 1,90			47	23			46	10								
≤ 2,12	68	48	50	25			49	11								
≤ 2,36			54	27			53	12								
≤ 2,65	68	48	58	29			57	14								
≤ 3,00	80	58	62	31			61	15								
≤ 3,35			66	33			65	16								
≤ 3,75			71	35			70	18								
≤ 4,25	93	68	76	38			75	19			76	38				
≤ 4,75			81	41			80	21			81	41				
≤ 5,30	100	73	87	44	133	23	86	23			87	44			155	73
≤ 6,00	135	105	93	47	138	26	93	26			93	47			187	105
≤ 6,70			100	50	144	28	101	28	151	75	100	50	137	61		
≤ 7,50			107	54	150	31	109	31	156	80	107	54				



# Reaming



$d_1$	DIN 9		DIN 206		DIN 208		DIN 212		DIN 311		DIN 859		DIN 1895		DIN 2180	
	$l_1$	$l_2$	$l_1$	$l_2$	$l_1$	$l_2$	$l_1$	$l_2$	$l_1$	$l_2$	$l_1$	$l_2$	$l_1$	$l_2$	$l_1$	$l_2$
mm	mm		mm		mm		mm		mm		mm		mm		mm	
≤ 8,50	180	145	115	58	156	33	117	33	161	85	115	58			227	145
≤ 9,50			124	62	162	36	125	36	166	90	124	62				
≤ 10,60	215	175	133	66	168	38	133	38	171	95	133	66	142	66	257	175
≤ 11,80			142	71	175	41	142	41	176	100	142	71				
≤ 13,20	255	210	152	76	182	44	151	44	199	105	152	76			315	210
≤ 14,00					189	47	160	47	209	115						
≤ 15,00	280	230	163	81	204	50	162	50	219	125	163	81	173	79		
≤ 16,00					210	52	170	52	229	135					335	230
≤ 17,00			175	87	214	54	175	54	251	135	175	87				
≤ 18,00					219	56	182	56								
≤ 19,00			188	93	223	58	189	58	261	145	188	93				
≤ 20,00	310	250	201	100	228	60	195	60							377	250
≤ 21,20					232	62			271	155	201	100	212	96		
≤ 22,40			215	107	237	64										
≤ 23,60					241	66			281	165	215	107				
≤ 25,00	370	300			268	68									427	300
≤ 26,50			231	115	273	70			296	180	231	115	263	119		
≤ 28,00					277	71										
≤ 30,00	400	320	247	124	281	73			311	195	247	124			475	320
≤ 31,50					285	75			326	210						
≤ 33,50			265	133	317	77			354	210	265	133				
≤ 35,50					321	78										
≤ 37,50			284	142	325	79			364	220	284	142				
≤ 40,00	430	340			329	81			374	230			331	150	495	340
≤ 42,50			305	152	333	82					305	152				
≤ 45,00					336	83										
≤ 47,50			326	163	340	84			384	240	326	163				
≤ 50,00	460	360	347	174	344	86			394	250	347	174			550	360

## REAMER FORM AND DIN DESIGNATION

DIN	Form	Description
212	<b>A</b>	Straight Flute $\leq$ 3.5mm diameter
	<b>B</b>	Spiral Flute $\leq$ 3.5mm diameter
	<b>C</b>	Straight Flute $\geq$ 4.0mm diameter
	<b>D</b>	Spiral Flute $\geq$ 4.0mm diameter
	<b>E</b>	Quick Spiral
208 219	<b>A</b>	Straight Flute
	<b>B</b>	Spiral Flute
	<b>C</b>	Quick Spiral
9, 205,206, 859, 8050, 8051, 8093, 8094	<b>A</b>	Straight Flute
	<b>B</b>	Spiral Flute
1895	<b>C</b>	Spiral Flute
	<b>D</b>	Quick Spiral
	<b>E</b>	Straight Flute

Spiral Flute = 7° left hand spiral  
Quick Spiral = 45° left hand spiral

# Reaming

## TROUBLE SHOOTING WHEN REAMING

PROBLEM	CAUSE	REMEDY
Broken or twisted tangs	Incorrect fit between shank and socket	Ensure the shank and the socket are clean and free from damage
Rapid Tool Wear	Insufficient stock to remove	Increase the amount of stock to be removed (See Page 52)
Oversize Hole	Excessive lip height variation	Regrind to correct specification
	Displacement in the machine spindle	Repair and rectify spindle displacement
	Defects on the tool holder	Replace tool holder
	Tool shank is damaged	Replace or regrind the shank
	Ovality of the tool	Replace or regrind the tool
	Asymmetric bevel lead angle	Regrind to correct specification
	Too high feed or cutting speed	Adjust cutting conditions in accordance with Catalogue or Product Selector
Undersize hole	Insufficient stock to remove	Increase the amount of stock to be removed (See Page 52)
	Too much heat generated while reaming. The hole widens and shrinks.	Increase coolant flow
	The tool diameter is worn and is undersize.	Regrind to correct specification.
	Too low feed or cutting speed	Adjust cutting conditions in accordance with the Dormer Product Selector.
	Pre-drilled hole is too small	Decrease the amount of stock to be removed. (See Page 52)
Oval and conical holes	Displacement in the machine spindle	Repair and rectify spindle displacement
	Misalignment between tool and hole	Use a bridge reamer
	Asymmetric bevel lead angle	Regrind to correct specification

PROBLEM	CAUSE	REMEDY
Bad Hole finish	Excessive stock to remove	Decrease the amount of stock to be removed (See Page 52)
	Worn out tool	Regrind to specification
	Too small cutting rake angle	Regrind to specification
	Too diluted emulsion or cutting oil	Increase % concentration
	Feed and/or speed too low	Adjust cutting conditions in accordance with Catalogue/ Product Selector
	Cutting speed too high	Adjust cutting conditions in accordance with Catalogue/ Product Selector
The tool clamps and breaks	Worn out tool	Regrind to correct specification
	Back taper of the tool is too small	Check and replace / modify the tool
	The width of the land is too wide	Check and replace / modify the tool
	Workpiece material tend to squeeze	Use an adjustable reamer to compensate for the displacement
	Pre-drilled hole is too small	Decrease the amount of stock to be removed (See Page 52)
	Heterogeneous material with hard inclusions	Use solid carbide reamer