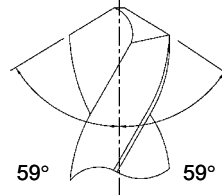


Regrinding

DRILL POINT AND REGRINDING

To produce a perfect drill point, the following must be correct:

1. Point Angle
2. Chisel Edge angle
3. Initial clearance
4. Total clearance



Standard 118° Point Angle

Standard drills are ground with an included point angle of 118°. They are established as the most suitable for general purpose work.

If the correct initial clearance is produced and increased gradually towards the centre to produce a chisel edge angle of approximately 130°, the correct clearance will be achieved along the whole of the cutting lips.

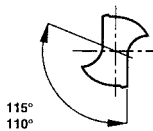
Drill Diameter mm	Initial Clearance Angle at Periphery
Up to and Including 1	21° - 27°
Over 1 to 6	12° - 18°
Over 6 to 10	10° - 14°
Over 10 to 18	8° - 12°
Over 18	6° - 12°

The two cutting lips lengths should be equal and at a similar angle to the drill axis, to provide correct balance and concentricity.

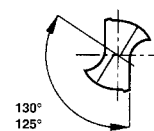
Split point geometry, DIN 1412 Type C

Due to the relatively thick web, it is necessary to grind away the flank of both cutting lips in two stages:

- Grind with required point angle (normally 118° or 135°) and a chisel edge angle of 110°–115°.
- Using the corner of the wheel, grind the secondary clearance (normally 35°–45° to the drill axis) to produce a cutting edge at the chisel, leaving 0.1 to 0.25 mm of the original chisel edge remaining.



115°
110°
Chisel Edge Angle



130°
125°
Thinning Angle



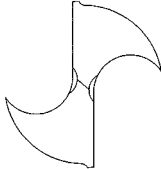
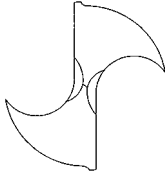
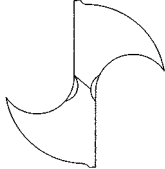
Note: If in any doubt we suggest you take an unused split point A120 drill, over 2.9mm, and use this as a pattern for regrinding worn drills.

WEB (CORE) THINNING, DIN 1412 TYPE A

Generally, drills are designed so that the thickness of the web gradually increases from the point to the run out of the flutes providing added strength and rigidity. It is not usually necessary to thin the chisel edge of a new drill. When about a third of the useful length

has been ground away, the chisel edge has widened to such an extent that it needs to be thinned. If this is not done, the drilling thrust is considerably increased. Holes that are out of roundness or oversized may result, since the drill will not self-centre.

Web thinning must be carefully carried out and where possible this should be done on a point-thinning machine. If a machine is not available then a shaped grinding wheel half the width of the flute is most effective. Equal amounts of material must be ground from each side of the chisel, which must be thinned, to approximately 10% of the drill diameter.

<p>Correct Web Thinning</p>  <p>Note how thinning is blended evenly into the flutes. An equal amount of material has been removed from each side and the chisel edge has not been excessively reduced.</p>	<p>Excessive Web Thinning</p>  <p>An equal but excessive amount of material had been removed from the chisel edge. This has weakened the drill point and can cause the web to split.</p>	<p>Uneven Web Thinning</p>  <p>Excessive material has been removed on one side of the chisel edge causing an unbalanced drill. The result will be oversized holes and may cause the drill to break.</p>
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TOLERANCE LIMITS ON THE CUTTING DIAMETER OF STANDARD DRILLS

Dormer produces standard drills in accordance with the appropriate national or international standards.

The standard tolerance on diameter measured across the outer corner, immediately adjacent to the point, is h8 in accordance with British Standard, ISO and DIN as specified below.

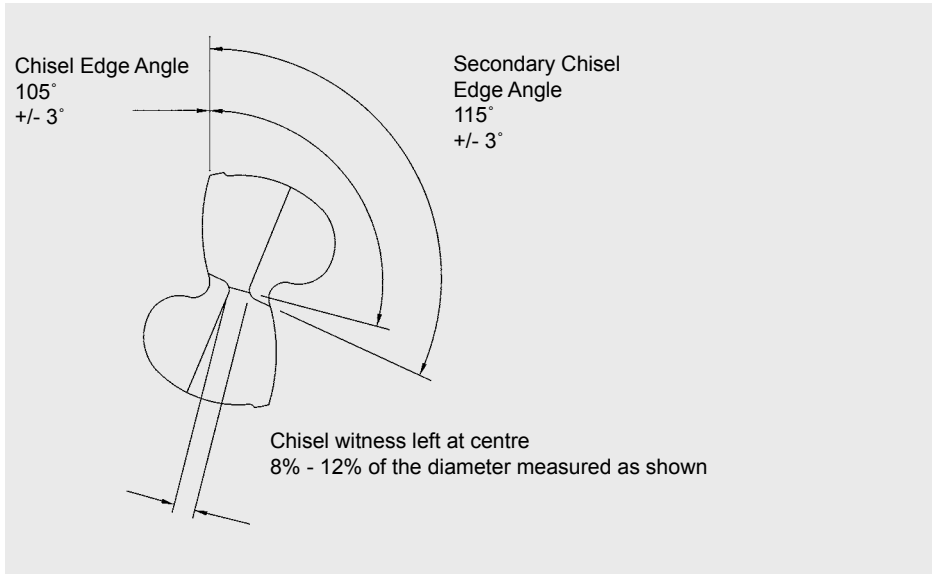
MILLIMETRES			
Diameter		Tolerance Limit	
Over	Up to and including	High +	Low -
	3	0	0.014
3	6	0	0.018
6	10	0	0.022
10	18	0	0.027
18	30	0	0.033
30	50	0	0.039
50	80	0	0.046

INCHES			
Diameter		Tolerance Limit	
Over	Up to and including	High +	Low -
	0.1181	0	0.0006
0.1181	0.2362	0	0.0007
0.2362	0.3937	0	0.0009
0.3937	0.7087	0	0.0011
0.7087	1.1811	0	0.0013
1.1811	1.9685	0	0.0015
1.9585	3.1496	0	0.0018

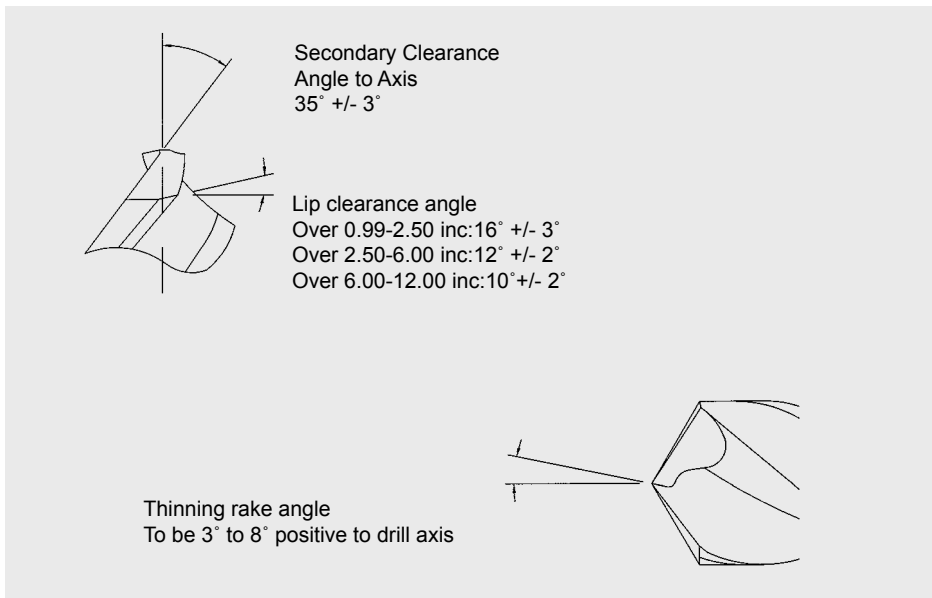
Regrinding

HEAVY DUTY DRILLS // PFX

POINT REGRINDING DETAILS

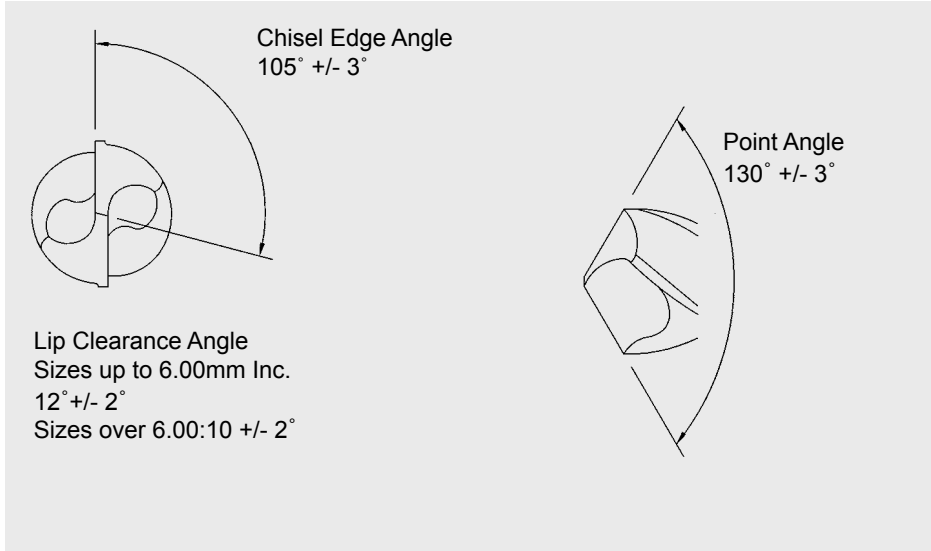


WEB THINNING DETAILS

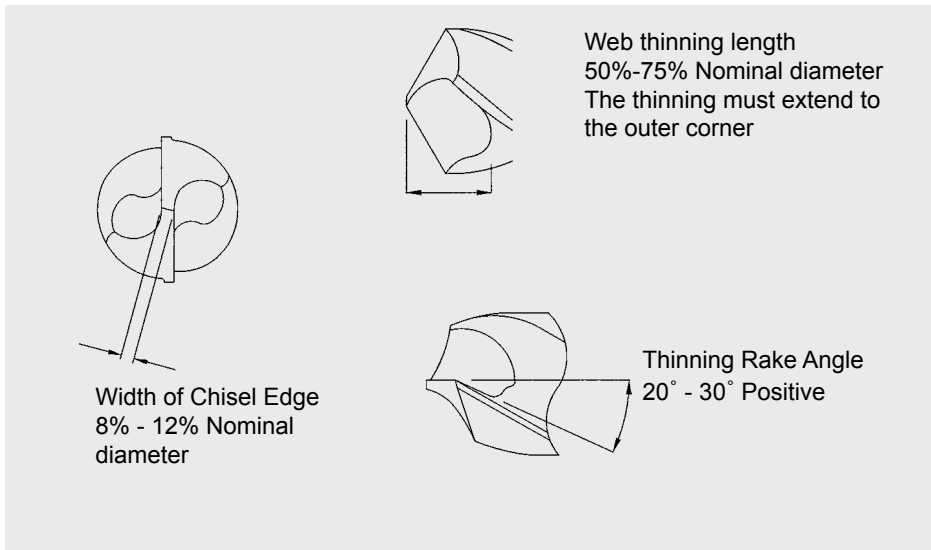


EXTRA LONG SERIES DRILLS // PFX

POINT REGRINDING DETAILS



WEB THINNING DETAILS



Regrinding

POINT REGRINDING INFORMATION

A510 // A520

Chisel Centre Error

0.05 TIV, MAX (mm)

Lip Height Variation (mm)

Sizes	3.0 - 13.0	0.025 Max
Over	13.0 - 14.0	0.050 Max

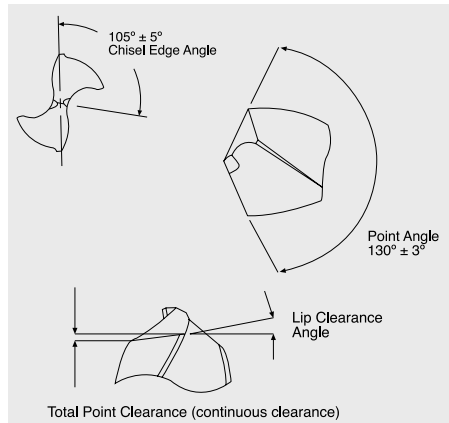
Lip Clearance Angle

Sizes	3.0 - 6.0 inc.	11° - 15°
Over	6.0 - 10.0 inc.	10° - 14°
Over	10.0 - 13.0 inc.	8° - 12°
Over	13.0 - 14.0 inc.	6° - 10°

Total Point Clearance (mm)

(should be continuous clearance)

Sizes	3.0	0.20 - 0.40
Over	3.0 - 4.0 inc.	0.25 - 0.45
Over	4.0 - 6.0 inc.	0.25 - 0.50
Over	6.0 - 8.0 inc.	0.30 - 0.55
Over	8.0 - 10.0 inc.	0.35 - 0.60
Over	10.0 - 13.0 inc.	0.40 - 0.80
Over	13.0 - 14.0 inc.	0.50 - 1.20



A551 // A552 // A553 // A554

Chisel Centre Error

0.05 TIV, MAX (mm)

Lip Height Variation (mm)

Sizes	5.0 - 13.0 inc.	0.025 Max
Over	13.0 - 20.0 inc.	0.050 Max

Volute Clearance

The value of the Volute Clearance should be:
 50% - 75% of the resultant total point clearance;
 (ie. resultant total point clearance; 0.60mm.
 volute clearance: 0.30mm - 0.45mm)

The position for measuring the Volute Clearance should be as stated in the table opposite and measured from the centre as shown.

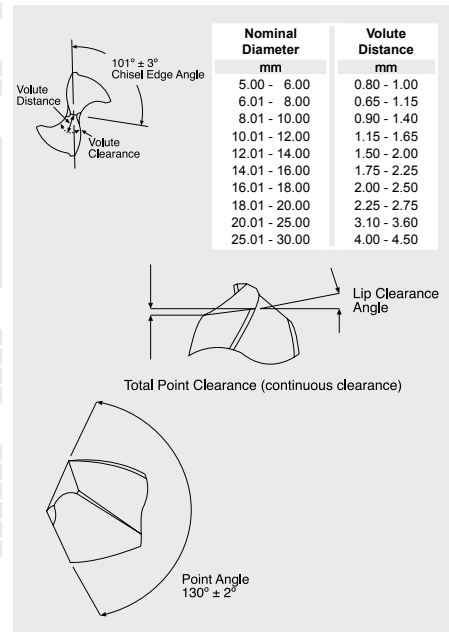
Lip Clearance Angle

Sizes	3.0 - 6.0 inc.	11° - 15°
Over	6.0 - 10.0 inc.	10° - 14°
Over	10.0 - 13.0 inc.	8° - 12°
Over	13.0 - 30.0 inc.	6° - 10°

Total Point Clearance (mm)

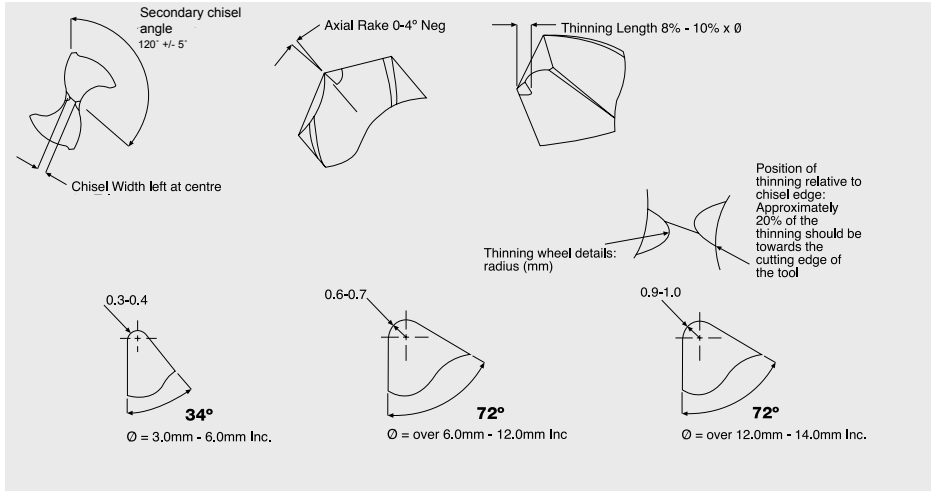
(should be continuous clearance)

Sizes	5.0 - 8.0 inc.	0.20 - 0.45
Over	8.0 - 10.0 inc.	0.25 - 0.45
Over	10.0 - 13.0 inc.	0.40 - 0.60
Over	13.0 - 20.0 inc.	0.50 - 0.70
Over	20.0 - 30.0 inc.	0.70 - 1.10

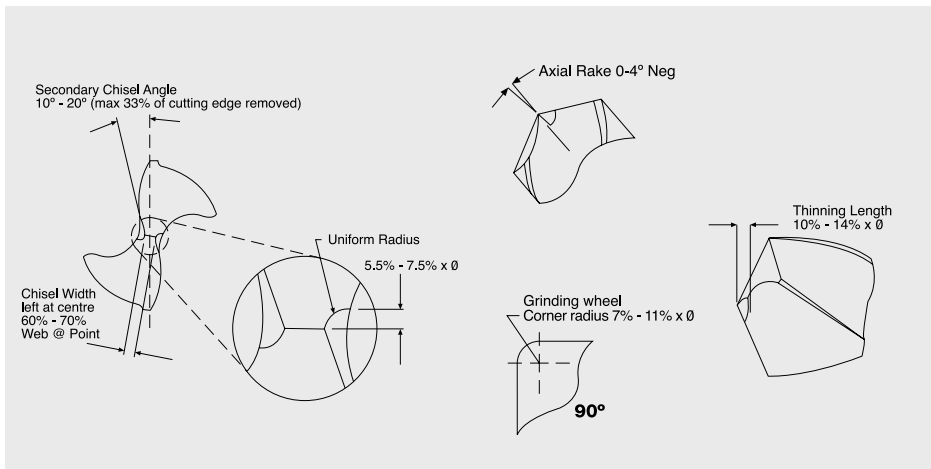


Web Thinning Details

A510 // A520



A551 // A552 // A553 // A554



Regrinding

CDX REGRINDING INFORMATION

Recommendations

Follow these recommendations with the drawing of the CDX point geometry as a reference.

- Regrind so that the coating in the flutes and on the lands is undamaged.
- The variations in web thinning should be <math><0.025\text{mm}</math>.
- Use a diamond grinding wheel and a liberal supply of cutting compound.
- Use a stable grinding machine.
- If in any doubt we suggest you take an unused CDX drill and use this as a pattern for regrinding worn drills.

Avoid

Do not use the drills for too long before regrinding. Do not grind by hand.

Procedure

In order to restore the drills to a condition for best possible results after regrinding, we recommend the following three-stage process:-

I. GRINDING PRIMARY AND SECONDARY CLEARANCES (SEE DRAWINGS OPPOSITE)

1. Set the machine to a 130° point angle.
2. Set the secondary clearance angle to $17-25^\circ$.
3. Grind the secondary clearance angle until it is in a position beyond the centre line on the cutting edge.
4. Set the primary clearance angle to $6-10^\circ$
5. Grind until the junction of primary and secondary clearances is over the centre line of the tool to the heel side to result in a chisel angle of $102-110^\circ$.

Point angle $130^\circ \pm 2^\circ$

Clearance	6-10°, ground over the center line shown in fig.1	
	Diameter mm	Dimensions A and B mm
	3.0 - 8.0	0.10 - 0.25
	8.1 - 12.0	0.15 - 0.30
	12.1 - 16.0	0.20 - 0.35
	16.1 - 20.0	0.25 - 0.45

II. WEB THINNING

1. Use a 60° diamond-grinding wheel with a corner radius. We recommend the following

Diameter mm	Grinding Wheel radius	Length of web thinning
3.0	0.25	0.50 - 0.80
4.0	0.25	0.60 - 0.90
5.0	0.25	0.70 - 1.00
6.0	0.25	0.95 - 1.25
7.0	0.35	1.10 - 1.50
8.0	0.35	1.20 - 1.60
9.0	0.55	1.30 - 1.70
10.0	0.55	1.40 - 1.80
11.0	0.55	1.40 - 2.00
12.0 - 13.0	0.55	1.50 - 2.10
14.0 - 15.0	0.70	1.70 - 2.30
16.0	0.70	1.95 - 2.55
17.0 - 18.0	0.90	2.10 - 2.90

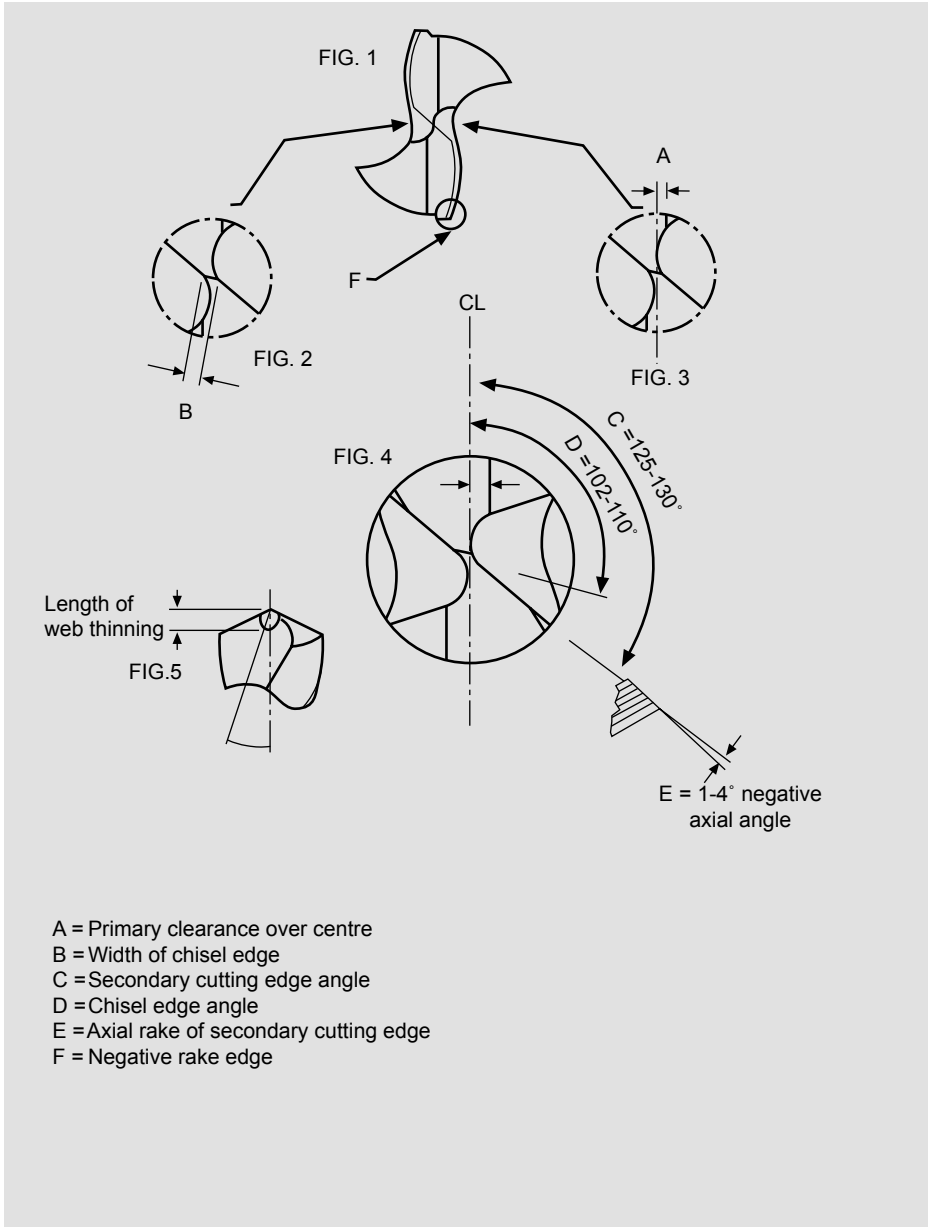
2. Set the machine so that the axial rake at the secondary cutting edge by thinning is between -1° and -4° .
3. For best results, grind until the amount specified in the regrinding figure (dimensions A and B) is achieved.
4. The web thinning must never go beyond the centre line, (Fig.3)

III. NEGATIVE RAKE

A negative rake edge with an angle of $20-35^\circ$ to drill axis along the full cutting lips, with a width acc. to the table below in the direction of grinding, up to the secondary cutting lips is recommended. This should be produced by grinding or with a diamond finishing stick, to produce a smooth surface finish.

Negative rake on cutting lip, dim.F Diameter mm	20-35 degree negative Width of rake mm(Axial)
3.0 - 6.0	0.03 - 0.07
6.1 - 10.0	0.03 - 0.10
10.1 - 14.0	0.03 - 0.12
14.1 - 20.0	0.03 - 0.15

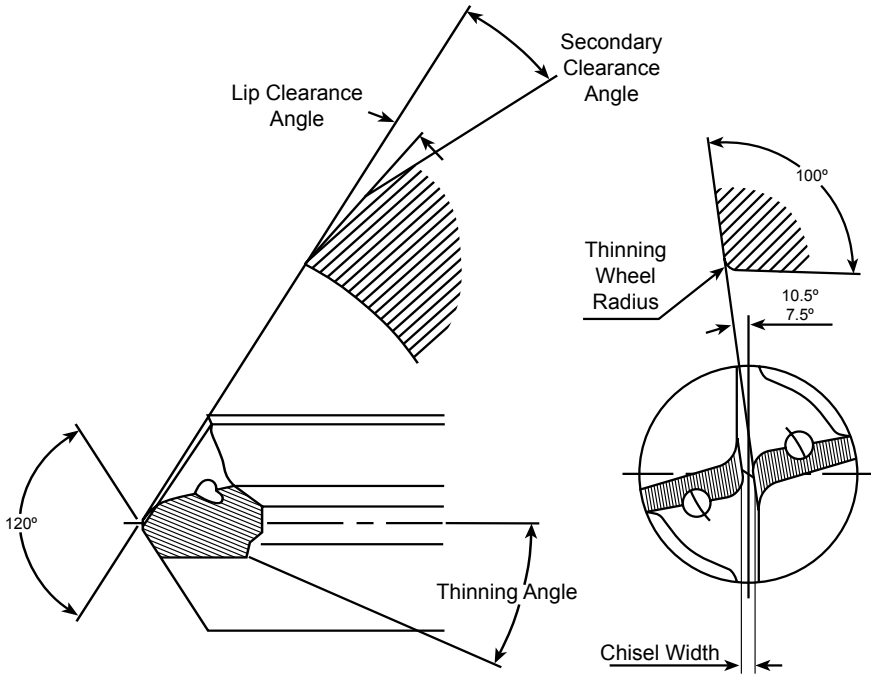
REGRINDING OF CDX DRILLS



- A = Primary clearance over centre
- B = Width of chisel edge
- C = Secondary cutting edge angle
- D = Chisel edge angle
- E = Axial rake of secondary cutting edge
- F = Negative rake edge

Regrinding

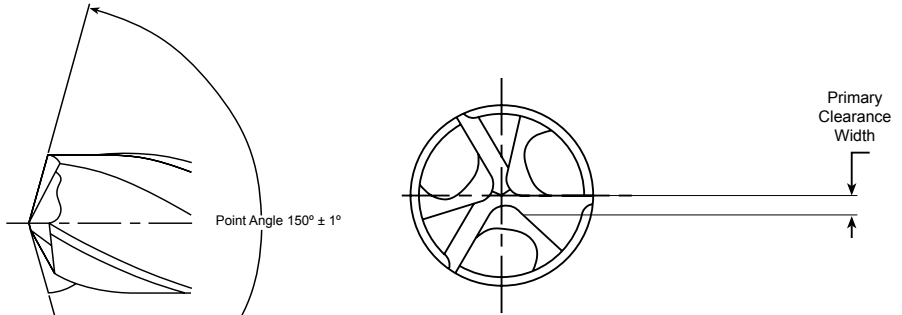
R210/R220 REGRINDING INFORMATION



Diameter	Lip Clearance Angle	Secondary Clearance Angle	Chisel Width	Thinning Wheel Radius	Thinning Angle
5	13°	25°	0.3	0.5	24° - 26°
6	12°	25°	0.36	0.6	24° - 26°
8	11°	25°	0.48	0.8	24° - 26°
10	10°	25°	0.6	1.0	24° - 26°
12	9°	25°	0.72	1.2	24° - 26°
14	8°	25°	0.84	1.4	24° - 26°
16	7°	25°	0.96	1.6	24° - 26°
18	7°	25°	1.08	1.8	24° - 26°
20	6°	25°	1.2	2.0	24° - 26°

R325 REGRINDING INFORMATION

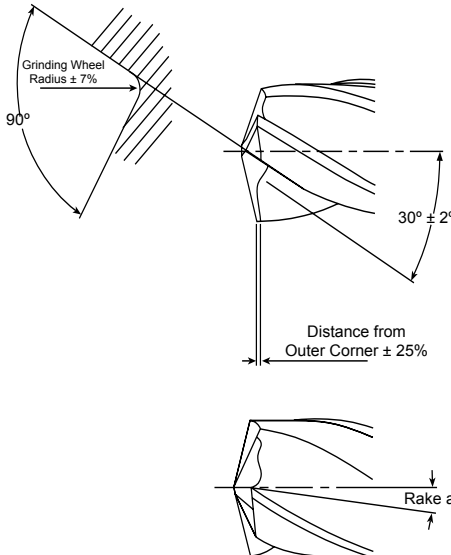
POINT GRINDING DETAILS



Drill Diameter	Primary Clearance Angle	Secondary Clearance Angle
3.0 - 4.2	10° +/- 1°	N/A
4.5 - 7.8	9° +/- 1°	16° +/- 2°
8.0 - 9.8	8° +/- 1°	16° +/- 2°
10.0 - 15.8	7° +/- 1°	16° +/- 2°
16.0	6° +/- 1°	16° +/- 2°

Drill Diameter	Primary Clearance Width +/- 14%
3.0 - 4.0	N/A
4.2 - 4.8	0.31
5.0 - 5.8	0.35
6.0 - 7.8	0.42
8.0 - 9.8	0.56
10.0 - 11.8	0.70
12.0 - 13.8	0.84
14.0 - 15.8	0.98
16.0	1.12

POINT THINNING DETAILS

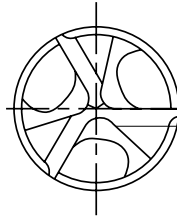
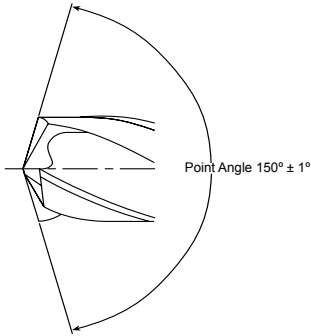


Drill Diameter	Distance from Outer Corner	Grinding Wheel Radius
3.0 - 3.8	0.14	0.40
4.0 - 4.8	0.17	0.55
5.0 - 5.8	0.20	0.65
6.0 - 7.8	0.23	0.75
8.0 - 9.8	0.29	1.05
10.0 - 11.8	0.35	1.30
12.0 - 13.8	0.39	1.55
14.0 - 15.8	0.43	1.85
16.0	0.49	2.05

Regrinding

R330 REGRINDING INFORMATION

POINT GRINDING DETAILS

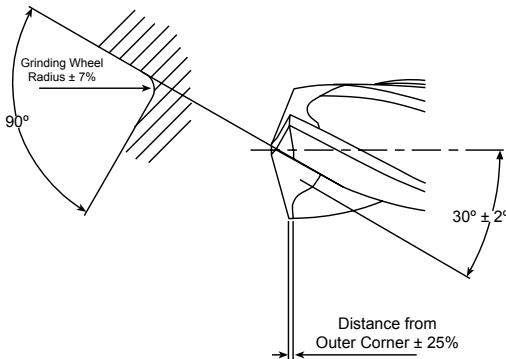


Primary Clearance Width

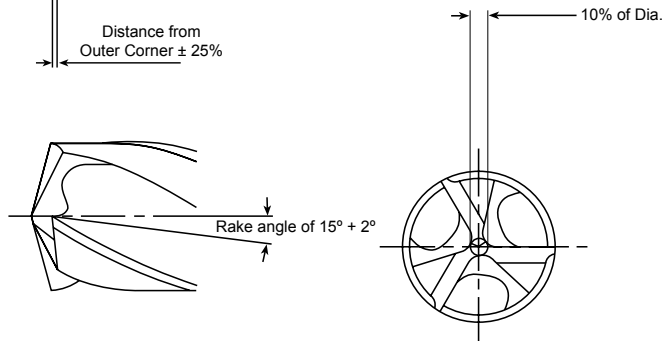
Drill Diameter	Primary Clearance Angle	Secondary Clearance Angle
3.0 - 4.2	10° +/- 1°	N/A
4.5 - 7.8	9° +/- 1°	16° +/- 2°
8.0 - 9.8	8° +/- 1°	16° +/- 2°
10.0 - 15.8	7° +/- 1°	16° +/- 2°
16.0	6° +/- 1°	16° +/- 2°

Drill Diameter	Primary Clearance Width +/- 14%
3.0 - 4.0	N/A
4.2 - 4.8	0.31
5.0 - 5.8	0.35
6.0 - 7.8	0.42
8.0 - 9.8	0.56
10.0 - 11.8	0.70
12.0 - 13.8	0.84
14.0 - 15.8	0.98
16.0	1.12

POINT THINNING DETAILS



Drill Diameter	Distance from Outer Corner	Grinding Wheel Radius
3.0 - 3.8	0.27	0.40
4.0 - 4.8	0.33	0.55
5.0 - 5.8	0.39	0.65
6.0 - 7.8	0.44	0.75
8.0 - 9.8	0.55	1.05
10.0 - 11.8	0.65	1.30
12.0 - 13.8	0.75	1.55
14.0 - 15.8	0.84	1.85
16.0	0.93	2.05



Reamers are precision tools, which have to be very exact with regard to dimensional accuracy and geometrical style. For this reason the tools are manufactured between centres.

Before regrinding, the tools have to be checked between centres for concentricity. The centres have to be undamaged. If the tools are found to be eccentric, they have to be straightened at the soft part of the shank.

It is very important to regrind the reamer before too much wear or damage has occurred. When the cutting chamfer is dull, the cutting edges and faces are stressed too much and the circular grinding chamfer gets used up. This means that even after resharpener the holes do not have exact size. When regrinding without coolant, avoid intense heating, otherwise HSS cutting edges burn out and carbide tips get grinding cracks.

REGRINDING OF CUTTING CHAMFER

Hand reamers, machine reamers and shell reamers for cylindrical bore holes are resharpener at the cutting chamfer. **The relief angle α of the first cut should be 5 - 8°.** It can be reached by changing the height of the support finger. With tool grinding machines with a rotating grinding spindle, the support finger has to be adjusted to the height of the centers and the grinding spindle has to be rotated to the required relief.

SUITABLE GRINDING WHEELS:

HSS tools: potters wheel, special fused alumina, grain size 60, grade K - L

Carbide tools: diamond wheel, resinoid bond, concentration 75, grade D, grain size 90

REGRINDING FACE

On reamers used for cylindrical bore holes it is sometimes also necessary to regrind the face. During this operation, a part of the circular land has to be preserved. The tool back rake angle should not be changed. Press the reamer slightly by hand towards the grinding wheel and move the reamers to left and right direction. If the pressure of the tool towards the grinding wheel is too high, the grinding wheel becomes deformed. This leads to a rounded minor cutting edge. The tool back rake is 3 - 6° positive.

SUITABLE GRINDING WHEELS:

Diamond wheel, resinoid bond, grade D, grain size 30

At relief grind of the circular land, the support finger has to be mounted at the column of the machine. The support finger and this part of the grinding wheel, which cuts, have to be at the same point so a symmetrical land can be produced. The reamer clamped between centres is held by hand. Press the face of the tool slightly against the support finger. By moving the supporting table to the left and right direction, the support finger will work as a guide. The relief angle can be adjusted by putting the finger higher or lower. Spiral fluted reamers can be ground the same way.

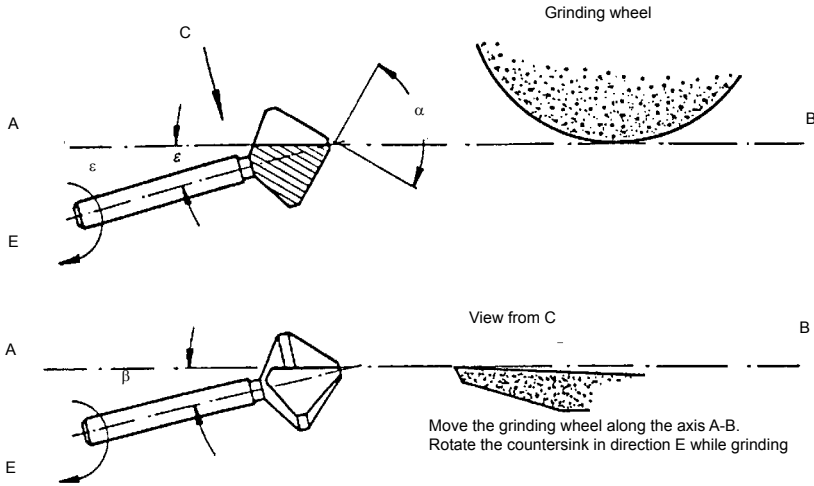
Regrinding

SUITABLE GRINDING WHEELS:

Diamond wheel, resinoid bond, concentration 75, grade D, grain size 90

NOMINAL \varnothing	CHAMFER WIDTH	RELIEF ANGLE
2	0,15 – 0,20	$\approx 25^\circ$
4		16 – 18 °
6		12 – 14 °
10		11 – 13 °
10 – 20	0,15 – 0,25	10 – 20 °
> 20	0,20 – 0,30	8 – 10 °

REGRINDING OF 3 FLUTE COUNTERSINKS



Shank	Diameter from up to and Incl.	α	β	ϵ
Cyl.	6.3 - 25.0	60°	10.5°	22°
MK	16.0 - 31.5 40.0 - 80.0			12°
Cyl.	4.3 - 6.3	90°	12.5°	29°
	7.0 - 13.4			
	15.0 - 31.0			
MK	15.0 - 31.0	90°	14°	15°
	34.0 - 37.0			
	40.0 - 80.0			

Regrinding

A worn tap has a tendency to chip or break, cut oversize or produce rough, poor quality threads. It requires higher power on the spindle and needs more time for the tapping cycle.

Generally, a tap needs to be reground when the roundness on the cutting edge has the same or even greater thickness than the chip. The remedy is to regrind, and it is cost effective mainly for big sizes > M12.

Regrinding of taps should, if possible, take place on a tap grinder and not be done by hand. The most important thing is to regrind with the original lead angle and to keep the same rake angle and relief for each flute. This can only be achieved using a tap grinding machine.

Wear on a tap extends on the cutting edge and on the outer diameter, but generally the bigger part is on the chamfer length. This portion removes the majority of material and withstands the higher loads during tapping. Generally it is sufficient to regrind just this part, removing the worn portion, in order to resharpen the tap.

The chamfer and accompanying relief on the top of the thread should be identical on all of the lands of the tap. If the chamfer is uneven, the result will be holes much larger than the tap size, torn and misshapen threads, uneven wear and eventual breakage of the taps.

When the edges of the thread begin to dull or become nicked, the flutes should be reground. A flute grinder providing accurate indexing of the cutting edges should be used. Unless the indexing is accurate, the tap is liable to break or cut oversize.

Regrinding of the flutes can also be undertaken in cases where there is a lack of suitable equipment for grinding the chamfer.

Note when regrinding:

- Grind the tap between centres and check it does not have radial run out.
- Grind the chamfer land following the original relief, using the outer face of a cup wheel or a disk wheel (see left fig. on next page).
- Grind the chamfer with a wheel having the chamfer angle β or incline the tap by the same amount if using a flat wheel (see left fig. on next page).
- The equal division of the cutting edges must be maintained.
- Grind the flute using a disk wheel, sharpened with the same flute profile of the tap (see right fig. on next page).
- The correct rake angle must be maintained – see rake angles table.
- The diameter of the tap will be reduced.
- The lands will be reduced and therefore will be weaker.
- Avoid forming burrs on the flanks of the thread form.



The chamfer angle (β) must be calculated in order to keep the same chamfer length as the original tap.

When regrinding the flute, the flank wheel is displaced in relation to the tap axis: the distance (X) is linked to rake angle (μ), see figure below. In this operation, it is very important to ensure a correct indexing on the machine, in order to keep the same wheel position for each flute.

Never regrind a damaged tap or a tap with build-up on the thread flanks.

Rake angles (μ) for taps

Material to be tapped	Rake angle (approx.) in degrees
Cast Iron	4-6
Malleable Cast Iron	5-10
Steel, up to 500 N/mm ² Tensile Strength	12-15
Steel, up to 1000 N/mm ² Tensile Strength	10-12
Steel, over 1100 N/mm ² Tensile Strength	7-10
Stainless Steel	8-12
Brass, cast	0-5
Aluminium	15-25

Chamfer Regrinding	Flute Regrinding
	
	Offset calculation $x = \frac{d * \sin(\mu)}{2}$

Dormer thread milling cutters are tooth form corrected (head depth, tooth depth) and thread angle corrected. The cutters are form relieved to allow several regrinding operations with no loss of profile.

With the tooth form correction, the profile distortion is counteracted through the movement of the screw. Here, the relationships between the diameter and the pitch are decisive factors. The correction of the thread angle is dependent upon rake angle, relief and spiral angle of the thread milling cutter.



Distortion of the flank with form relieved thread milling cutters with varying rake angles

As the thread milling cutters are only reground on the cutting face, the following requirements are imperative for the regrind:

- Firstly the rake angle must be strictly adhered to from 6° to 9° - measured at the profile height. It must be noted that the cutting face up to the area under the "web" of the profile is as straight as possible. Deviations in the rake angle result in a change in the thread angle, which means that the thread milling cutter is no longer able to produce a thread to standard. (Moreover in the case of metric threads, the profile height is around 60% of the pitch.)
- The spiral angle must also be considered. Thread milling cutters in the Dormer standard range have a spiral angle of 10° . On special tools this can be different. Please contact Dormer for more information.



For each tool there is an economically optimum time for regrinding. This time depends on the land wear, which in turn depends on the period of use and on the cutting parameters. The period of use is often determined by size of the workpiece.

Cutter wear is usually seen on the primary clearance. It causes the component surface finish to worsen and cutter vibration to increase.

A useful aid in this case is a power input gauge on the milling machine. If the instrument registers a rise, this generally indicates increased tool wear. Exceeding the specified permissible land wear results in a rapid increase in the cutting force due to the dull cutting edge, which, if left unchecked, may lead to tool fracture.

There are two types of cutter profiles:

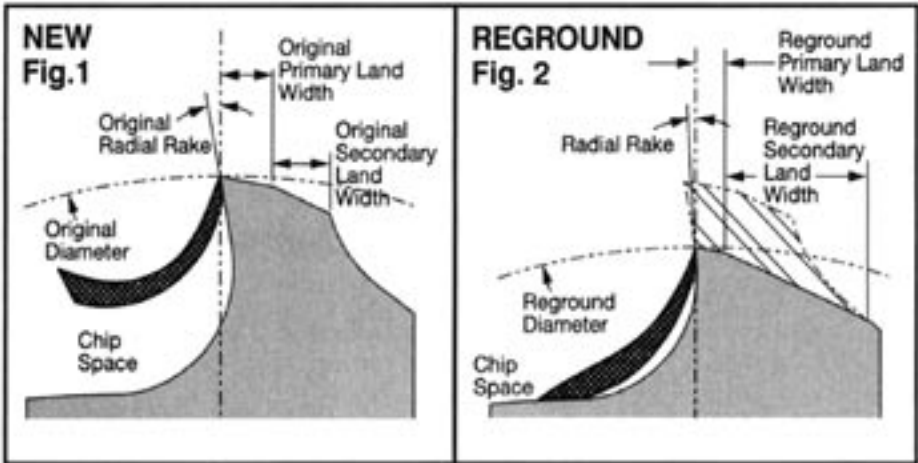
Archimede profile	Double-end profile
<p>The diagram shows a cross-section of a milling cutter with an Archimede profile. It features a curved undercut face on the left, a flat top land, and a secondary relief face on the right. Dimension lines indicate: 1 (undercut face), 2 (rake angle), 3 (width of land), and 4 (relief angle).</p>	<p>The diagram shows a cross-section of a milling cutter with a double-end profile. It features a curved undercut face on the left, a primary relief land, a secondary relief land, and a secondary relief face on the right. Dimension lines indicate: 2 (rake angle), 5 (primary relief angle), 6 (width of primary relief land), 7 (primary relief angle), and 8 (secondary relief angle).</p>
<ol style="list-style-type: none"> 1. Undercut face 2. Rake angle 3. Width of land 4. Relief angle 	<ol style="list-style-type: none"> 5. Width of primary relief land 6. Width of secondary relief land 7. Primary relief angle 8. Secondary relief angle
<p>With this profile it is possible to regrind only the undercut face. If the land is too badly damaged, then it is also necessary to regrind the land by creating a double-end profile (see right column).</p>	<p>With the double-end profile the regrinding will begin with the primary land and will continue with the secondary land.</p>

Regrinding

RESULTS OF REGRINDING

Reduction in Diameter

A loss in diameter occurs when grinding the periphery of the primary land. This progressively impacts the end mill's deflection capacity when under load. Compare Figs. 1 and 2.



Reduction In Radial Rake Angle

An end mill must possess a rake angle that is suitable for the material being machined. After each regrind there is not only a reduction in diameter, but also a subsequent reduction in the radial rake angle. This, together with the corresponding, if slight change, in helix angle significantly affects the efficiency of the end mill. Compare Figs. 1 and 2. Face rake angles can be re-established by regrinding the flute face of the end mill

Increase In Secondary Land Width

The secondary land width increases substantially as a result of regrinding, which in turn increases regrinding time and cost. Compare Figs. 1 and 2.

Reduction In Flute Depth

As a consequence of reducing diameter, there is a corresponding reduction in the flute depth. Because of the subsequent impact on chip evacuation capabilities it can force the utilisation of feed rates that would be considered far less efficient. Compare Figs. 1 and 2.

Please contact your local Dormer sales company for information on our Regrinding Service.

