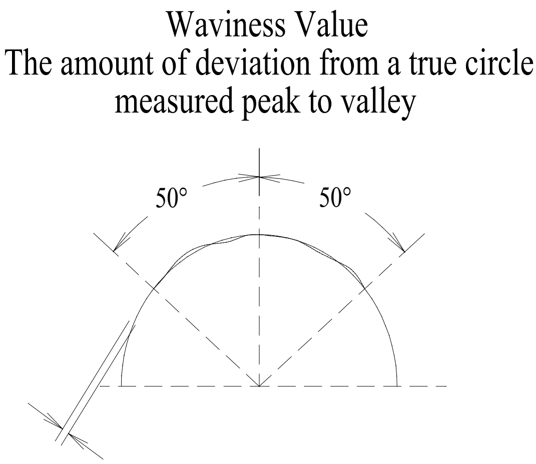
Two axis cutting:

Controlled-Waviness Tools:

The type of tooling available and what tools to use.

When cutting using a 2-axis method the type of tool used needs correct consideration. Production costs can be dramatically affected by the correct planning of tool type and tool path.

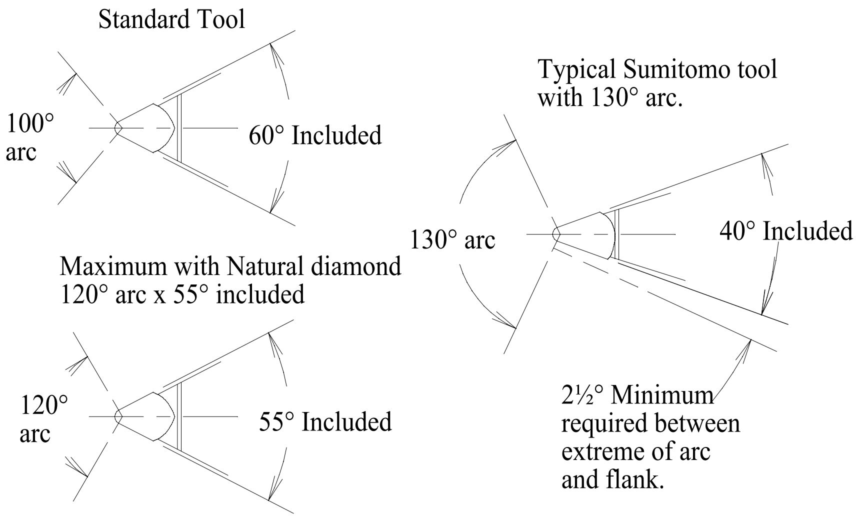


The only difference between controlled waviness tools and non-controlled is how well we control the deviation of the radius shape from a true circle. Any error in the radius shape will be directly transmitted into the part you are cutting. Contour measure this as a peak to valley value over a given amount of arc. All other aspects are the same: the same high standard of workmanship, quality of diamond, quality of radius surface finish and of cutting edge.

Controlled waviness tools.

Controlled waviness means the radius deviation from a true circle is a much lower value. This deviation is measured and guaranteed. The measurement is shown on a chart supplied with the tool. It is the controlling of the radius, the radius size, and the amount of arc that add cost to the tool. Always take care not to use controlled tools unnecessarily (where a roughing tool will be adequate).

The standard amount of arc supplied is 100°. Generally this will cut most individual parts, so long as the arc can be rotated to the correct position (a hemisphere only needs 90° arc if the tool is correctly positioned and is able to fit within the part).



When using natural diamond, we prefer to limit to 100° arc - but can produce 120° if necessary (the last 10° each side tends to be slightly less accurate. This is due to the diamond grain orientation). If more arc is required we have to change to a Sumitomo diamond. We always need a minimum of 5° (2½° each side) between the arc extreme and the included angle for manufacturing purposes. We can, if required, make up to 164° of controlled waviness arc.

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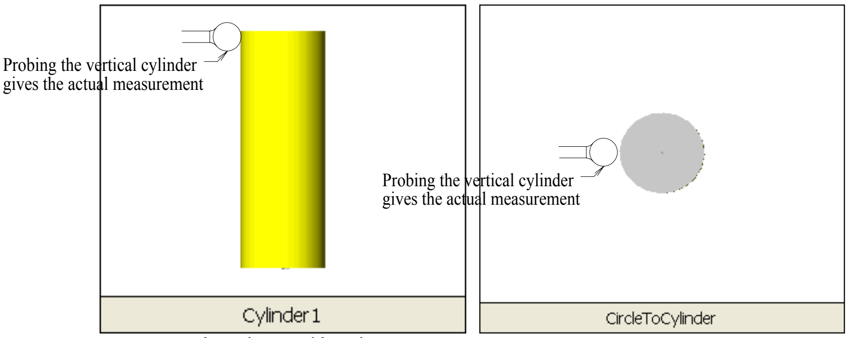
Two axis cutting:

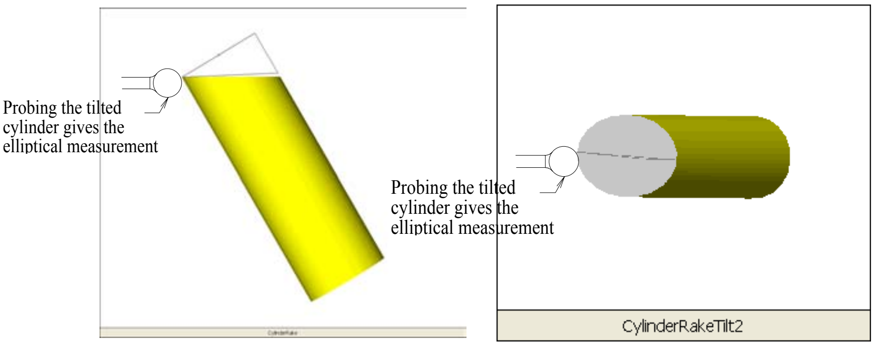
Controlled-Waviness Cylindrical Clearance Tools:

When manufacturing cylindrical clearance conrtolled-waviness tools, the cylinder is manufactured to the required tolerance. However, because cylindrical tools have an elliptical effect, due to the clearance, there can be an additional waviness issue. The sketch shows the cylinder being measured in its vertical position (as manufactured) vs. its elliptical position (as used).

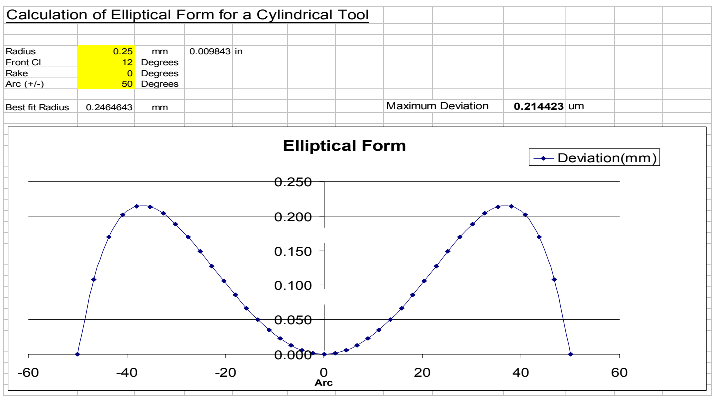


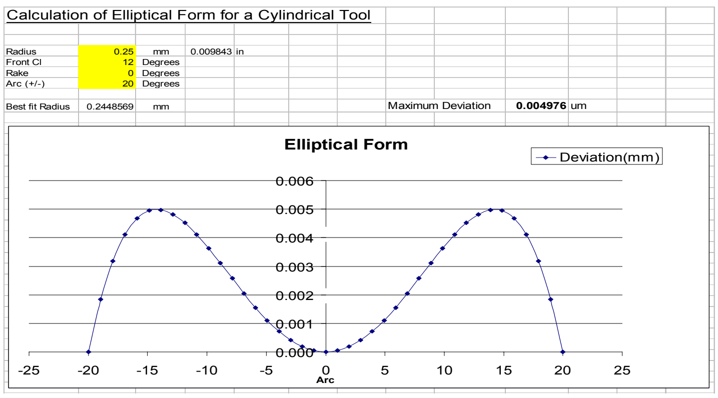
Vertical Cylinder as Manufactured

A typical 0.25mm radius tool with 12° F.C. and 100° arc will have an elliptical wave of 0.214µm waviness over the full 100° arc. However, if the amount of arc used is cut down to 40° then the waviness on this same tool will be .0005µm, which at such a low value can, in our opinion, be disregarded as a source error.



Tilted Cylinder as Used





The elliptical effect for a typical 100° arc tool:			
Radius:	0.25mm	Front Clearance:	12°
Rake Angle:	0°	Arc	**100°**
Effective Waviness	**0.214423µm**		

The elliptical effect for a typical 40° arc tool:			
Radius:	0.25mm	Front Clearance:	12°
Rake Angle:	0°	Arc	**40°**
Effective Waviness	**0.004976µm**		

Please note: these charts show elliptical contribution to waviness error only, any waviness error in the diamond tool will be additional.

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Two axis cutting:

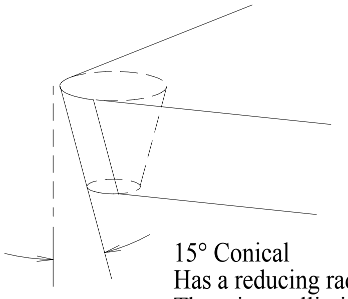
Controlled-Waviness Conical Clearance Tools:

➢Allows for a true circular shape.

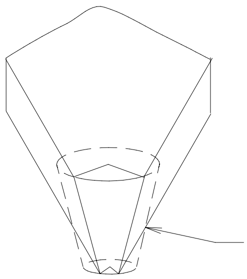
➢Clearance angle is the same around all of radius arc and flank angles.

➢Radius size (and therefore length of cutting edge) reduces every time the tool is relapped.

➢The elliptical form does not occur on conical clearance tools so long as a 0° rake is used. Any error is purely from manufacturing tolerances. The radius size does reduce down the clearance angle. Every time the tool is relapped the radius becomes slightly smaller e.g. on a tool with 14° front clearance, if 0.04mm is removed on relap then 0.01mm is lost in radius size (1:4 ratio with 14° clearance). If the best waviness accuracy is required then conical clearance is essential.



15° Conical
Has a reducing radius size.
There is no elliptical effect



Conical clearance
has the same cutting
clearance all round

Waviness values

Contour is pleased to offer a wide range of waviness values. This allows you to get the best value.
The waviness values available are:

<1.0µm
<0.75µm
<0.5µm
<0.25µm
<0.15µm
<0.10µm
<0.05µm – Yes, that's less than fifty nanometers.

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