

# Technical Reference

## Mechanical Limits of Engine Turning

### How deep is engine turning and what thickness of metal is required?

If one has made the piece and it is strong enough to sell then it is thick enough for turning. The minimum thickness is generally 0.1mm when restoring the turning on an antique watch back. Most engine turning is done with a shallow vee tool angle of 12 degrees and a line spacing of about 1/2mm. This gives a depth of 0.106mm at the bottom of the vee, in practice about 0.13mm

### How deep does one recess for enamel?

Normally 0.3 to 0.35mm for the primary recess which is then increased a little by the scraping and stoning, plus the depth of the engine turning in the bottom of the recess.

For some dark colors, some enamellers like to use a heavy coat to build up the depth of color rather than use an even darker enamel because it is easier to get an even color - not patchy. If you need this you might want as much as 0.5mm primary recess depth.

### What is the maximum depth you can cut?

This is very machine and job dependent. Close to the nose of the machine on a Plant it is possible to take out a channel 6mm deep by 6mm wide in brass-in segments. Some wide deep vee cuts are about 2 to 3 mm deep and it is possible to score sheets for folding up to 2mm thick. Some items cut to match certain watch brands are recessed and ribbed 2 1/2mm deep. The most important thing to remember is that deep cutting takes time due to many passes of the tool. Often if one wants something to appear bold it is the width of cut rather than the depth that will achieve the result and at the same time save time (money).

Depth of cut is also very much restricted by the strength of the workpiece and its size. Don't try to cut deep ribs on the end of a big box!

### How finely can you cut and what are the units of division on the (Plant) machines?

The standard Plant Sliderest has a 14tpi thread, subdivided with a ratchet of 64 teeth, thus giving a finest resolution of 896 divisions per inch (25.4mm).

The Crossing Slide, which moves the pattern bar vertically relative to the workpiece and tool is 10 tpi divided into 100 giving 1000ths of an inch.

The Sunray Wheel has 120 teeth, and on most machines is subdivided by the use of notched wheels having 3,4,5,6,7,10,12 or 14 notches. There are also machines with a 48 tooth ratchet on the sunray wheel giving a finest resolution of 5760 and all divisors thereof.

There are Pencil Chucks with 54, 72 and 96 toothed worms, also with various notched wheels.

### What is the Maximum Cut Length and what is the longest object you can cut?

The Maximum Cut Length on most machinery is 14 inches (355mm), though for Low relief the limit is about 8 inches (200mm).

It is possible in certain instances to exceed the Maximum Cut Length on a Plant 14 inch Straight Line

Machine by carefully joining up several cuts. This is highly skilled work and requires a powerful microscope on the machine.

#### What is the biggest Circle or Oval diameter possible?

With most machines about 16 to 18 inches, but there are large rose engines that can cut a circle of slightly more than 1 metre diameter, and can handle ovals on this scale too.

#### What is the largest Box or Picture Frame one can hold on a Straight Line Machine?

The obvious limit would be what would go down the well of the machine which is about 11 or 12 inches by about 6 (300x150mm) by 14 inches Max Cut Length but we have handled bigger items than this using various machine extension methods and Joining Cuts.

Joining of cuts in a pattern is not at all easy and is only viable with certain suitable patterns.

#### Can you engine turn the inside of an object?

Yes! If possible you cheat and engine turn it while it is still flat. It can easily be spun up, formed or pressed after engine turning without damaging the pattern. This is by far the best solution with the greatest freedom of design.

If one can't do this then you have to watch out for clearance problems very carefully. The chief requirement is that the tool must at all times remain perpendicular to the surface of the workpiece. The ends of the arc slide and the front of the tool slide are the usual problem with clearance in inside turning.

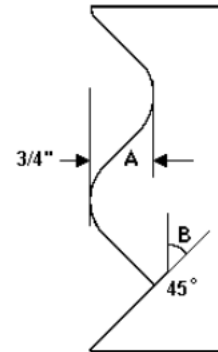
#### The Physical Limits of Straight Line Pattern Bar Profile Design

The Maximum Amplitude (**A**) of the wave or zig zag should not exceed about 3/4 inch (20mm) on most straight line machines.

The Maximum angle of deviation (**B**) from the primary (vertical) direction of cut should not exceed 45 degrees for ease of cutting and minimising wear on the Bar, Touch and Machine Slides.

The useful vertical extent or length of the bar is limited to the maximum travel of the mainslide of the particular machine, which is the Maximum Cut Length.

To see the effect of different touch profiles goto [Bars and Touches](#).



#### What Materials are suitable for Engine Turning?

Every material used by the gold, silver and allied trades but some materials are significantly better than others.

In brief, the worst materials are soft copper, soft (GW) platinum in particular, CZ121 brass, certain white golds particularly soft ones, anything with nickel in it, tool steels in the annealed or normalised condition, soft aluminium, niobium (easy to cut but requires a poisonous coolant), plus a few others.

Examples of good materials are 18ct hb yellow and many red golds, hard rolled Silver, CZ108 brass. Most golds are OK except soft white and fine gold, which is sticky and tends to cause a built up edge on the cutting tool. Where tool steel must be cut it should be slightly harder than normalised.

"Compo" engraving brass - CZ120 and CZ121 are OK provided a very light cut is used. This means that to get the best results it can take many tool passes to attain the full cut depth especially where the cut is deep.