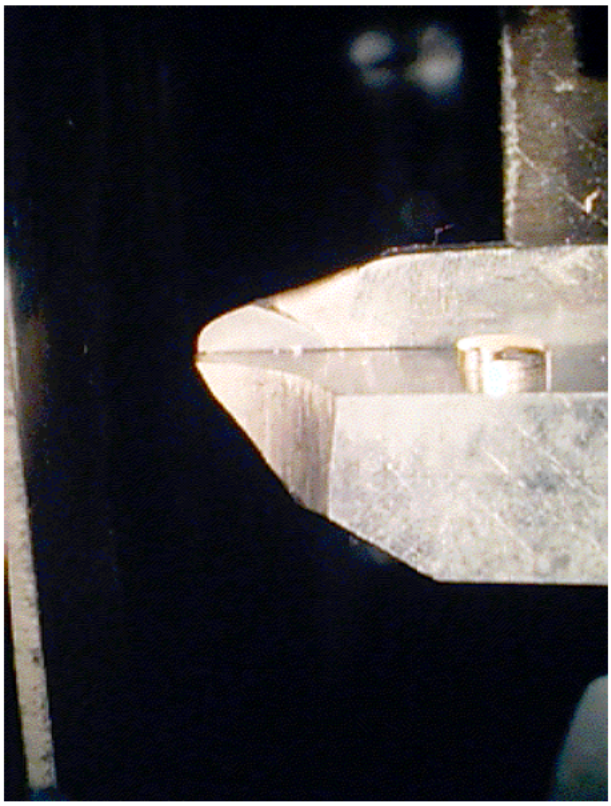
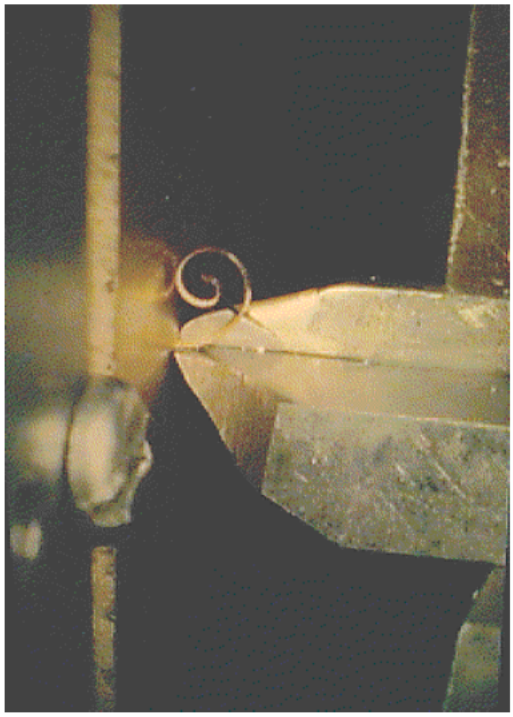
2. *Cutting Lines: The basis of all engine turning*

The Cutting Tool and the Function of the Guide

Here is a simple explanation of how the tool and guide are used to cut lines of even and precise depth. The illustrations here are on a straight line machine, but the principle of tool and guide apply equally to the circular machine. For low relief work, there is an added dimension of the fact that the tool and guide are able to move independently during the course of each cut.





The tool and guide viewed from the left side of the machine The tool is in the foreground, the guide immediately behind it in this image ***The Guide controls the depth of cut by following the surface very close to the edge of the cut.*** *For normal engine turning, The tool and guide are locked together while cutting takes place, though for deep cuts the guide may be withdrawn a fraction at a time as multiple passes of are made in the same cut to achieve the required depth*

The guide controls the depth as the tool cuts; it also helps to dampen out any chattering tendencies caused by flexing of the entire machine structure under the stress of the cutting forces. All machinery flexes in use, and these effects are measurable with sensitive instruments such as DTI guages. Temperature and settling also affect the quality of work. An engine turning machine is not simply ready for use when first placed in the workshop on the concrete floor. For the finest dial work, several months of settling in are required.

The guide is adjusted to set or change the depth by means of a micrometer screw on the tool slide. Another way to very gradually increase the depth of cut is to slightly rotate the arc slide to the left so that the tool, pivoting about the tip of the guide, which has previously been centred at the metal surface, rotates into the work. This method is particularly useful with difficult materials sunch as tool steels.

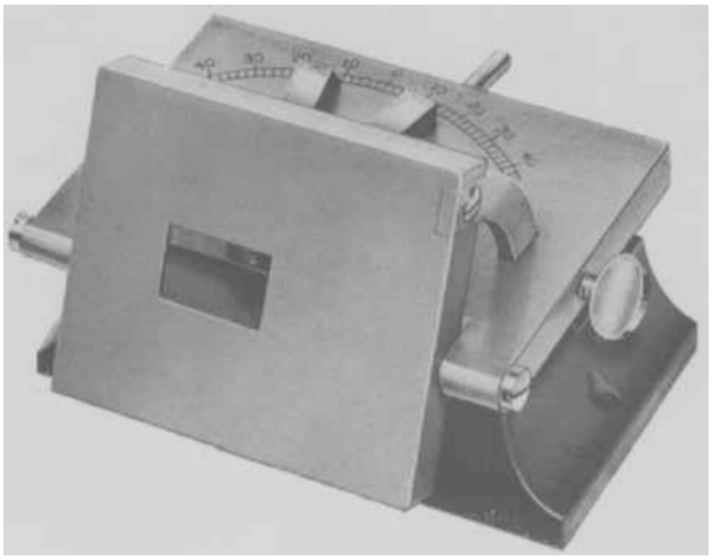
The tip of the guide in this example has been made from tungsten carbide to reduce wear. The tool is stellite in

this case; we also use other materials such as high speed steel, occasionally, tungsten carbide and diamond. Most tools, like this one, are ground from approx 6.5mm square stock. A curled brass chip or turning can be seen lying on top of the tool bit.

Making a cut. *The workpiece is moved downwards and the tool is pressed against it, restrained from digging in by the guide which, though adjustable, is fixed relative to the tool during a cut, except in the Low Relief or Brocade Engine Turning Machine As the tool cuts, metal is removed in a continuous chip With certain metals such as CZ121 brass there is a tendency for the chip to break which can induce tool chatter, unless the amount of metal removed in a single pass is very small*

The Goniostat - how the tool is prepared for use

The tool is prepared for cutting very carefully, with a very precise and finely polished edge, of better quality even than that of a razor blade, that can leave almost a mirror finish in the cut with silver and gold, maximising reflective quality, though the tool is of a very different cutting profile and style from a razor blade. A special jig called a goniostat is used for preparing the tool, with india and arkansas oil stones. There is quite a knack to successfully grinding and polishing a tool to the required standards. Apprentices typically take several weeks to perfect this vital engine turning skill, under close supervision.



Tool Sharpener or Goniostat Tools are ground to precise angles with India oilstone and the primary clearence polished to a mirror finish with Arkansas stone and oil Tool material may be High Speed Steel, or more often

Stellite which is much harder Occasionally for certain types of production work Tungsten Carbide is used, and also Polycrystaline and also Single Crystal Diamond We are also experimenting with some new materials, one problem is that we want to try things but can't get the right shaped blanks because modern machinery is not designed for 6 5mm square tools