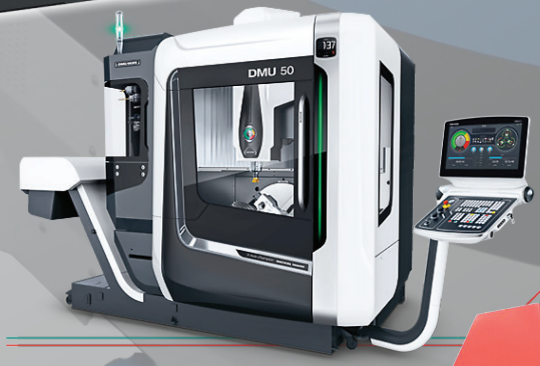
Zephyr Studies

Polishing Moulds for Curved Screen Mobile Phone

ZEEKO Ltd



Polishing Moulds for Curved Screen Mobile Phone

Case Study

Polishing Moulds for Curved Screen Mobile Phones

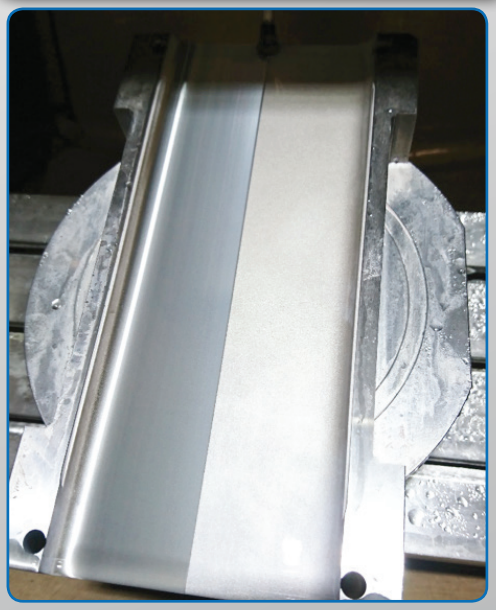
Zeeko is a well-known name in optics fabrication, building what is probably the most accurate polishing machine for freeform optics in the world. Using its own software and process technology, these machines have polished some of the best-known telescope and satellite optics yet produced, including many very complex X-ray telescope mandrels.

The Zeeko process for optics polishing has become well developed and mature over the years, and out of this work has recently evolved new tools, new software and new processes. Amongst these developments, processes have emerged that have made possible the automatic polishing of precision moulds for numerous applications including Head Up Displays (HUD's), precision injection moulds, precision moulds for glass press moulding of small lenses and now the polishing of moulds for the production of curved coverglasses for mobile phones screens.

These are produced in many different materials from graphite at one end of the scale through steel to tungsten carbide at the other end.

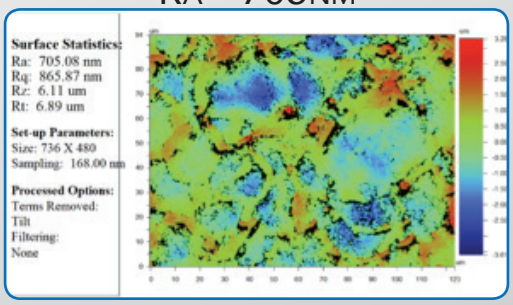
All are complex surfaces and have been polished by Zeeko, not only on their famous seven axis machines, but on the more competitively priced machining centre like the Fanuc Robodrill in five axis mode, that are built in high volume and represents excellent value for money.

This case study addresses the polishing of one of these moulds that might have been fabricated from any one of those materials – but in this instance, tungsten carbide has been used.

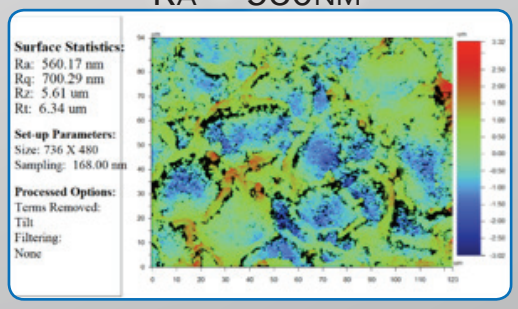


Tools and Polishing Strategy

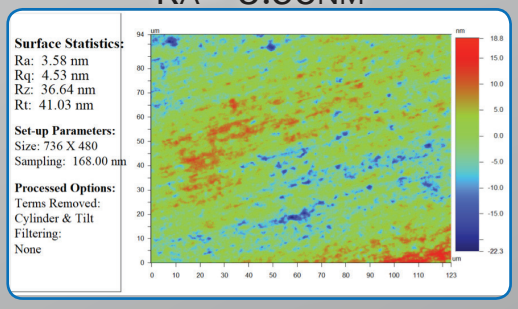
Starting Condition at Centre of surface Ra= 705nm



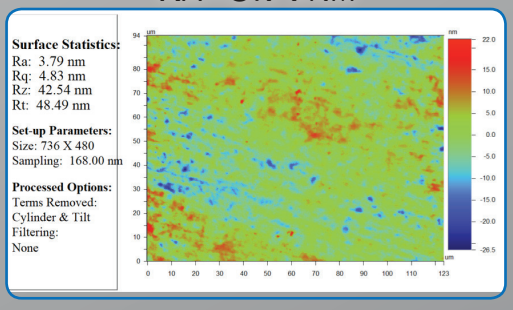
Starting Condition at Edge Roll Ra = 560nm



Mid-Condition at Centre of surface Ra= 3.58nm



Mid-Condition at Edge Roll Ra=3.79nm



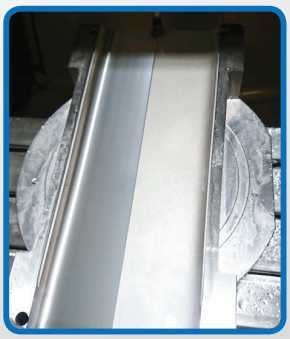
Zeeko has used its new Zephyr SAG polishing process based on the ductile regime grinding principle and its own Zephyr tools. The polishing machine is a standard three axis Robodrill milling machine from Fanuc, adapted to five axis operation by the addition of a standard Robodrill upgrade pack that included the fitting of a Nikken rotary tilt stage and additional amplifiers to support the contouring axes.

To ensure the process was run in a clean environment a five micron bag filter and a three micron in line filter was added to the coolant supply lines. To aid process set up, a Renishaw RMP 600 gauge was fitted to probe the part, and an optional Renishaw NC4 gauge was added for tool profiling purposes. The toolpaths for the polishing process were generated by the new Zeeko ZephyrCAM Software.

The tools selected for the polishing task were dictated by the shape of the part and some relatively tight shape constraints required the tools to be radius R=5mm. The tool type selected from the Zephyr tool catalogue was what is known as the ‘Teardrop’ design.

The initial approach to the polishing strategy was to use two different diamond abrasive Zephyr tools operating in the ductile regime. The first was 9µm nickel bond grit, then 3 µm resin bond grit used as a finishing tool.

First Polish using 9µm Nickel Bond Diamond Grit Zephyr SAG Tool



Surface Statistics:
Ra: 15.73mm
Rq: 20.32mm

Surface Statistics:
Ra: 23.08mm
Rq: 30.54mm

The workpiece was polished by SAG NBD 9um in 2 runs of 1H30 each the cosmetic improvement (mid polish) is shown below left and the measured improvement from:
Ra 705nm (Centre x50) and Ra 560nm (Edge roll x50) are shown at Ra 15.73 (Centre x50) andRa 23.08 (Edge Roll x50) respectively.

Second Polish using 3µm Resin Bond Diamond Grit Zephyr SAG Tool

Surface Statistics:
Ra: 3.58mm
Rq: 4.53mm

Surface Statistics:
Ra: 3.79mm
Rq: 4.83mm

The workpiece was polished by SAG RBD 3um in 2 runs of 2H00 each. The cosmetic improvement is shown below left (mid polish) and the measured improvement from:
Ra 15.73nm (Centre) and Ra 23.08 (Edge roll x50) are shown at Ra 3.58 (Centre x50) and Ra 3.79 (Edge Roll x50) respectively.

The Finished Part

A near mirror quality had been achieved

A near mirror-quality finish with Ra<2nm was achieved with just a 4 hour two step polish using the new Zephyr SAG tools and the new ZephyrCAM software.

Conclusion

As the reader will be aware, this example breaks new and exciting ground for the industry.
Here is a demonstrable process that can precision polish from a poor surface to a mirror finish with a simple two step procedure. The process can remove an even layer of material yet can also (on demand) improve the accuracy of the form. This is something that the mould industry, the precision engineering industry, nor the general engineering industry has seen before, and to demonstrate it on material as difficult to polish as tungsten carbide, is impressive.
The process is **even more effective** on a 3D printed/additively manufactured material.

This is a process with a lot of potential applications!

Please contact info@zeeko.co.uk or call +44 1530 815 832
for further information on this study, to order tools or to request
a 30 day free trial of the ZephyrCAM software

Zeeko Ltd | 4 Vulcan Court | Vulcan Way | Coalville | Leicestershire | LE67 3FW | United Kingdom
www.zeeko.co.uk