

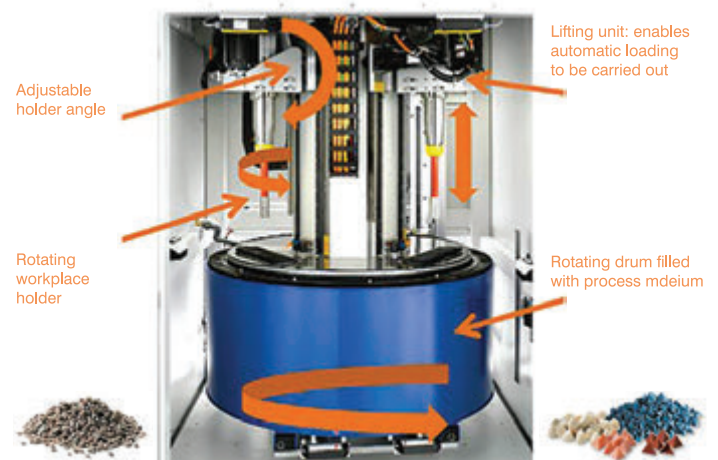
Pulse Surface Finishing: Higher Performance Gear Wheels that Require Fewer Oil Changes

Optimizing the finished quality of gear wheel contact surfaces has significant benefits for end users. Reducing friction means better performance, longer intervals between maintenance and often increased life expectancy for the part. Also, where oil lubrication is used, the reduction in abrasion positively contributes to much less fouling. This can extend oil change intervals considerably.

Mass finishing, the proven process for smoothing, polishing or grinding surfaces, has one drawback that makes it unsuitable for some tasks – that is it has a relatively low stock removal rate. Also, the complex component geometry of gear wheels means that they must be ground with abrasive media in the micro range size of 0.5 - 1mm, further diminishing the stock removal rate.

To solve this problem, Fintek are pioneering in the UK a new mass finishing process with a much higher stock removal rate where a gear wheel can achieve the specified finish in a shorter cycle time. This new 'Pulse Finishing' technique comes from the equipment manufacturer OTEC Präzisionsfinish GmbH.

How Otec Pulse Finishing Works



During pulse finishing, gear wheels are individually clamped in holders and processed in a stream of grinding or polishing medium rotating in alternating directions. Accelerating up to 2,000rpm takes just 0.5 seconds, followed by similar deceleration and this is repeated over and over. This process creates relative velocities of up to 30 m/s and acceleration forces of up to 40G.

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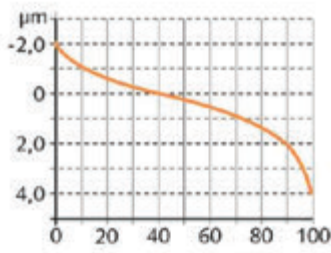
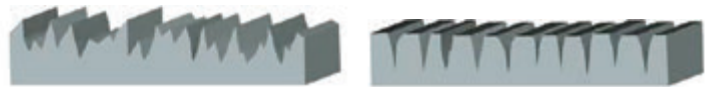


As the following surface tests show, mass finishing using the pulse finishing process removes the deep grooves caused by grinding, reducing roughness parameters and actively generating the necessary micro cavities.

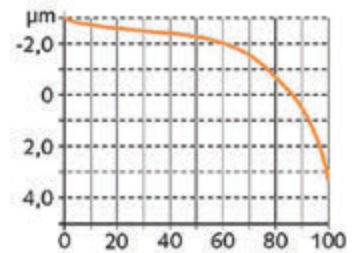
The coefficient of friction in a rolling contact, which is usually subject to the parameters Rk and Rpk, has been reduced by up to 30 percent in the case of mass finished discs. The fact that the roughness depth Rk and the peak height Rpk are the most significant parameters is probably because Rpk is initially relevant during running-in and Rk during subsequent operation. A reduced peak height Rk improves the contact surface area for the same Ra value.

Even a minimal change in the roughness values measured by a tactile sensor produces a considerable improvement in surface characteristics. With the pulse finishing process, roughness values of $Ra = 0.1 \mu m$ and $Rpk < 0.1 \mu m$ were achieved.

Camshaft Example



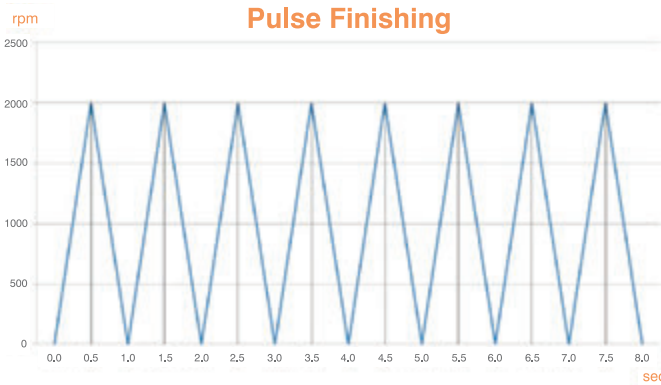
Amount of material in %
Conventional grinding process:
 $Ra = 0.2 \mu m$ and $Rpk < 0.2 \mu m$



Amount of material in %
Mass finishing using the pulse finishing process:
 $Ra = 0.1 \mu m$ and $Rpk < 0.1 \mu m$

Benefit of lowering the co-efficient of friction includes

- It reduces heat generation
- Better part performance
- Improved energy conversion efficiency of the tribological system
- Reduces noise generation by up to 50 percent when compared to conventionally ground gears
- The risk of metal fatigue damage caused by excessive increases in compression is less likely

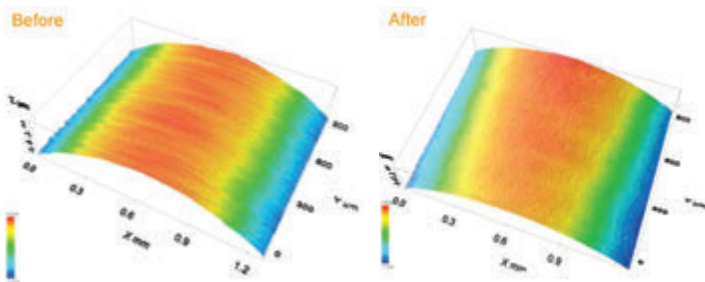


Commercially important is that an OTECE pulse finishing machine with four workpiece holders can fully finish a gear wheel every 15 - 20 seconds. Repeatability and speed is assured.

Testing the Surface Profiles of Pulse Finished Gear Wheels

The combination of process parameters which have the most beneficial effect on tribological performance are: speed of rotation, swivel angle of the gear wheels, pulse time, immersion depth and the process medium.

During tribological studies carried out on two-disc rolling contact tests, pulse finished surfaces showed that uniform, smooth surfaces with micro cavities and low Rpk values cause the least amount of wear and material loss through abrasion. The lubricating oil is able to collect in the micro-cavities creating 'oil valleys' not displaced upon surface contact. This contrasts favourably with the grooves that result from conventional grinding methods.



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