



Piston ring manufacturer doubles throughput

Precision Products UK (PPUK) is a leading manufacturer of chrome-plated piston rings, which are used principally in large bore two-stroke diesel ship engines.

There are a small number of piston ring manufacturers in the world for these types of ring and they struggle to meet global demand. If PPUK can increase capacity, there is a market need to be met and so a clear opportunity for growth.

Challenge

PPUK's customers require that piston rings be chrome plated to reduce wear in the hostile environment of diesel engines. Chrome plating is done via electrolysis, placing the piston ring in

a vat filled with a chrome solution and applying a current. It is a slow process which is hard to control accurately. For PPUK it takes 24 hours and represents a major constraint on productivity, which creates bottlenecks. Furthermore, the chrome plating can sometimes be unevenly distributed, requiring further work to produce the required finish.

PPUK worked with NPL through the Analysis for Innovators (A4I) Programme to better understand and find ways to improve product quality and speed up the process.

Solution

NPL set out to better understand the plating process and how it could be improved upon to make the process more efficient, whilst also improving how evenly the plating is applied. It worked closely with PPUK to design and conduct experiments to pin down the optimal approach.

The first step was to statistically analyse PPUK's existing measurement systems for chrome plating thickness, to assess the variability in the measurements.



This led to the introduction of more rigorous measurement systems, based on a statistically proven Standard Operating Procedure and understood capability of equipment.

NPL then designed experiments, carried out by PPUK, to understand how different variables affect the plating process and identify the optimal combinations. This process was run according to the Define, Measure, Analyse, Improve and Control (DMAIC) framework.

This started by defining a set of variables which could affect the speed and quality of the deposition process, including density of the electrolyte, temperature and position of the object in the tank. By varying each of these in a methodical way and measuring the changes to the plating thickness across the piston ring's surface over time, PPUK were able to establish cause and effect between the variables and the outcomes.

The measurements were analysed by NPL using Minitab analysis software, allowing them to identify whether each change directly impacted the plating process, whether that change was linear, and whether changing combinations of variables differed from changing them individually.

// We wouldn't hesitate recommending working with NPL – they brought expertise over and above our original expectations."

Mark Jenkins

Operations Director of PPUK



A4I

A4I is a programme that gives UK businesses, of any size, access to cutting-edge R&D expertise and facilities to help solve problems that they have been unable to tackle using standard techniques. The focus is on solving issues affecting product cost, reliability or lifetime and production problems.



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Impact

This allowed PPUK to identify the optimal conditions – such as the best temperature and current density – to grow the plating to the desired thickness and surface finish as quickly as possible, greatly improving its productivity.

The changes are expected to halve plating times, reducing electricity costs and speed throughput, thereby clearing a bottleneck in their manufacturing. For their largest customer, PPUK currently only meets 15% of demand, so increasing capacity represents a significant opportunity to grow revenue.

The project not only helped improve this process, but the understanding of DMAIC provided them with a methodology they can apply to other areas. This is immediately useful. One finding of the project was that chrome was deposited unevenly, prompting PPUK to move to a different style of anode in their plating instrument. They can now repeat the experiment with the new anodes to identify the best approach following the change.

Mark Jenkins, Operations Director of PPUK, said: "NPL helped us apply discipline to assessing and improving our processes, allied with proven measurement and control. This showed us how best practice can yield measurable benefits, that, combined with their close support in designing the experiment and rigorous analysis of the captured data, helped us significantly reduce our cycle time for the electroplating process."

"The upshot is – once rolled out fully – we will significantly increase capacity, enabling us to accept extra orders from our customers. Once we have made further changes to fully benefit from the faster plating times, we could be talking about doubling output."