ActiveEdge- Hydraulic Pump Case Study

ActiveEdge

Industry: Fluid Power Systems

Component: Hydraulic Pump

Component Material: Cast Iron

Customer: Unknown

Machine Spindle: HSK100

Completion Date: July 2015

Background Information

For this particular project, an industry leading manufacturer in the heavy plant industry was experiencing issues with **variation of bore sizes**. Bore data indicated a high deviation, with many bores often out of tolerance.

This problem was contributing to increased scrap and re-work rates, as well as quality and certification issues.

Rigibore tooling was selected to increase consistency and accuracy in the production of bores, ensuring a repeatable process the organisation could trust.

Fig.1- ActiveEdge tooling was integrated as part of a ***closed-loop process*** to improve accuracy and repeatability of bore sizes.

Operational Process

Pre-Design

Prior to design and manufacture of tooling for this application, Rigibore took time to review each machine in the operation, monitoring and recording the current machine patterns.

The experience of operators were used to gauge the cause of accuracy issues, helping to apply the most effective automated process.

Process Structure

The process for this operation required a flexible manufacturing structure, integrating 3 machine tools to successfully run a series of 10 gear pumps scheduled on part demand. Each of the series of parts required 3 precision bores:-

- ***A gear pocket bore*** (*Cast Iron*- With a tolerance of +/- 12 μm)
- ***A pre-bushing bore*** (*Cast Iron*- With a tolerance of +/- 12 μm)
- ***A bushing bore*** (*Aluminium*- With a tolerance of +/- 7 μm)

The bushing bore was individually machined using **Rigibore's ActiveEdge tooling**. This boring bar possesses the capability to automatically adjust, ensuring a close tolerance bored diameter without the need for operator intervention.

ActiveEdge's in-house design software RADS designed and manufactured the **bushing (pictured left)** and **pre-bushing (pictured right)** tools specific to the customers application.

Closed-Loop Manufacturing

For this particular project ActiveEdge technology was successfully integrated with partner products to form a ***closed-loop manufacturing process***.

Firstly, A **Baluff chip** was used to track which unique tool ID machined each of the bores. Next a **Renishaw Touch Probe** measured the bore diameter, storing these values in the **Siemens 840D** control to correspond with the tool ID that produced the bore.

Rigibore supply a set of **Statistical Process Control (SPC)** macros that run on the control, these carry out trend analysis on data from the probe, comparing bore sizes against a pre-determined upper and lower control limit set on bore sizes.

If the initial bore is not within the required tolerance band, an automatic adjustment request is sent to the tool via wireless radio signal, this adjustment is carried out in the ATC carousel, allowing the next bore to be machined at nominal size.

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Results

The two tables below outline the bore data from **February 2015** (Prior to implementation of ActiveEdge tooling) and **June 2015** (After implementation of ActiveEdge tooling).

Fig. 2 (February 2015)

Labels	Machine 1	Machine 2	Machine 3
Max.	0.01800	0.01500	0.02800
Min.	-0.02100	-0.01100	-0.03100
Aver.	-0.00050	0.00188	0.00050
Range	0.03900	0.02600	0.05900
Std. Dev	0.01342	0.00409	0.00925
Cp	0.32	1.06	0.47
Cpk	***0.31***	***0.91***	***0.45***
Yield	***62.5%***	***99.0%***	***88.9%***

Fig. 3 (June 2015)

Labels	Machine 1	Machine 2	Machine 3
Max.	0.00700	0.01200	0.00600
Min.	-0.00800	-0.00800	-0.00400
Aver.	-0.00118	-0.00110	0.00109
Range	0.01500	0.02000	0.00900
Std. Dev	0.00289	0.00374	0.00121
Cp	1.50	1.16	2.21
Cpk	***1.37***	***1.04***	***1.91***
Yield	***100.0%***	***100.0%***	***99.0%***

Cpk Statistics

The most drastic change after implementation of Rigibore's ActiveEdge tooling is the improvement in Cpk Statistics, a very important indicator of an organisations Process Capability.

All the statistics after implementation of ActiveEgde are above one, compared with February results where there is just one instance of a Cpk figure above one.

ActiveEdge Tooling and Cpk

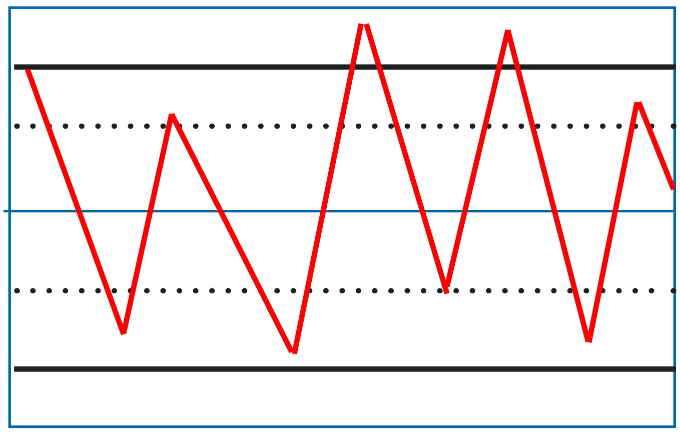

Fig. 4

This diagram illustrates bore data (red lines) prior to implementation of ActiveEgde tooling.

Adjustments being made manually mean a high deviation on bore sizes, towards and sometimes outside of the upper and lower tolerance (black lines).

Bore sizes are rarely close to the nominal tolerance (blue line) subsequently reflecting the poor Cpk statistics.

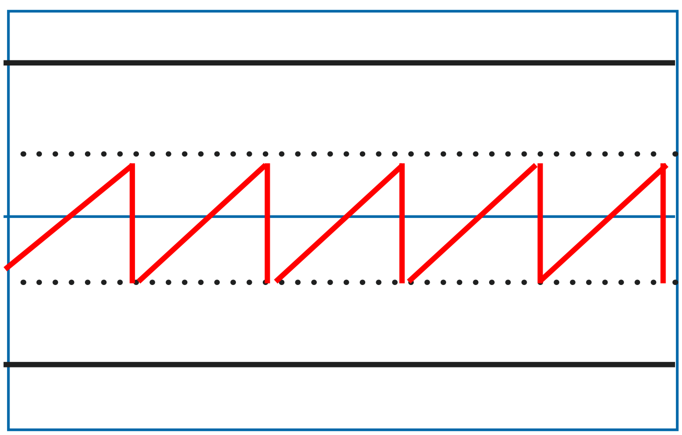

Fig. 5

This diagram shows the changes ActiveEdge tooling made to significantly improve process control in the operation.

Maintaining bore sizes within this narrow tolerance band between upper and lower control limits (dotted lines) ensures accuracy and repeatability of bore data.

Low deviation among bore sizes with all bores machined in close proximity to nominal tolerance.

The implementation of automation to this manufacturing operation ensured a close tolerance bore diameter was maintained throughout the operation.

This process played a key role in significantly reducing scrap and re-work rates, finding bore sizes to hold consistency and significantly improve surface finish when using ActiveEdge's unique technology.

Yield Statistics

Another noticeable difference between the two data sets before and after implementation of ActiveEdge tooling is the yield statistics.

Yield statistics can provide a important indicator of operational performance, organisations with a low yield percentage suffer negative cost and time implications.

Prior to implementation of ActiveEdge tooling, yield result were **62.5%**, **99.0%** and **88.9%**. This highlights a process inaccuracy, leading to significant loss on unusable component parts.

However, since application of ActiveEdge tooling, yield results had shown much increased repeatability and accuracy, the results being **100%**, **99.00%** and **100%**.

ActiveEdge's ability to maintain a close tolerance bore diameter throughout the duration of the operation, eliminating the possibility for oversized or undersized bores.