Shearing Machine Process Improvement

Western Carolina University
School of Engineering + Technology

Original Objectives

- Eliminate inconsistency in deviation from nominal in finished products
- Measure Process Data
- Determine Descriptive Statistics
- Construct D.O.E and Process Capability Study
- Upon reviewing analytic data provide theoretical solution
- Test and validate solution on site
- Provide OMG with necessary documentation to support new back gauge system

Requirements

Req #	Requirement	Description	Verification	Requirement Type	Affected Requirement
1	Final reading within variance of ± 0.015 in	The measurement after the part is cut should be within ± 0.015in	Test	Performance	2,4
2	Conducting a DOE (Design of Experiment)	Determining the relationship between factors and output.	Test/ Analysis	Performance	3,4
3	Following Applicable Standard & Specifications	Establish uniform criteria, process, methods, and practices	Test/Analysis	Functional	4
4	Standard: Process Capability ISO 9001:2015	Determining the process using indices such as Cp & Cpk	Test/ Analysis	Performance	1,2
5	Any additions to manual adjustment must meet OSHA requirements	Any new additions will be verified through OSHA safety regulations	Inspection	Function	1,4

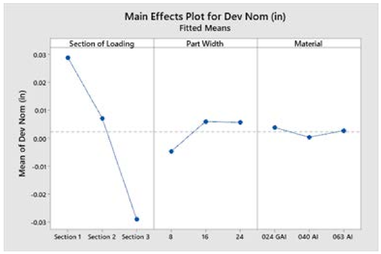
Concepts

- The team's attention was initially drawn to the current form of measurement. This included an encoder driven off a chain and sprocket mechanism.
- The team discussed their ideas on how to make the machine more accurate while leaving this component in place.

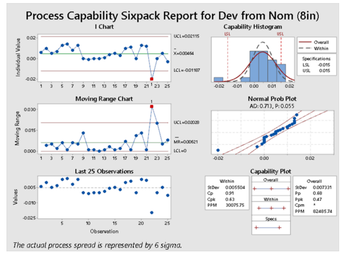
Problem Statement

OMG Edge Systems has three high volume production cells consisting of various types of equipment. The mechanical shear is operating correctly, the piece of equipment's measuring system is susceptible to wear and tear which will lead to even greater inaccuracy in tolerances. The shear machine is currently using a chain and sprocket system to adjust the distances of the back gauge or back stop. Due to the current system the machine is already showing typical signs of backlash. Producing finished products anywhere from 0.000 inches to 0.030 inches in tolerance. The goal is to minimize the variation and keep the tolerances closer to specification without altering the machines current process.

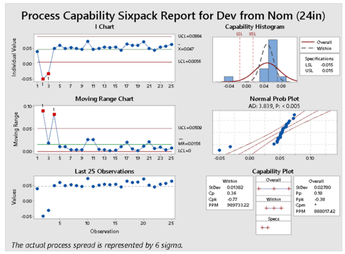
Final Design/Results *



The main effects plot determined by the Design of Experiments (DOE). It shows variables which may be significant in affecting the output.

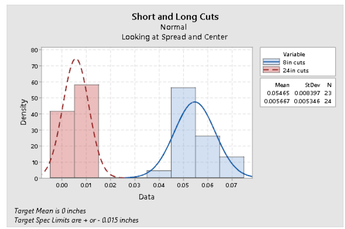


Determining Capability Indices for short length cuts



Determining Capability Indices for long length cuts

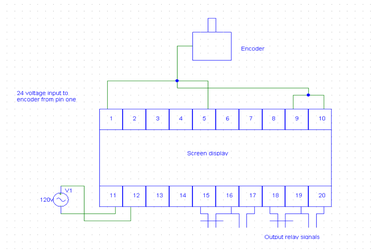
- Our DOE identified 'part widths' to be a significant variable
- Conducting a Process Capability Study showed that shorter and longer cuts had a noticeably different center and distribution
- A two-sample t-test determined the short cuts and long cuts to be different processes
- Currently the shear machine relies on a chain and sprocket system which is susceptible to wear and tear
- The team feels that the deviation caused by longer cuts could be steadied using a new form a measurement that does not rely on a chain and sprocket system – this being a string potentiometer



Normal Distribution Charts of short cuts and long cuts

String Potentiometer

- The machine's encoder is chain driven which allows for more error as the machine gets older with wear and tear. Our solution to this issue is a string potentiometer.
- The string potentiometer is used to detect and measure linear position and velocity using a flexible cable on a spring-loaded spool.
- The device will be attached to fixed point of the machine and the cable will attach to back gage itself. When the back gage moves, the device will count values and display them on a digital screen.
- The wiring diagram included is a drawing of an electrical schematic showing how the String Pot will be connected to the machine .



* On March 16, 2020 classes and labs were closed to students due to the COVID-19 Pandemic. Without access to fabrication and testing equipment, Objectives and Deliverables were modified accordingly.

Modified Objectives*

What had to be modified due to COVID-19?

- String Pot Implementation phase was affected due to the COVID-19 outbreak.
- Project Turnover Document was created and turned over to OMG's Engineer Caleb Kiser
- Another D.O.E and Process capability test will need to be taken after installation of String Potentiometer
- Tests will provide data verifying whether solution had positive or negative effects on the shearing machine.
- The team made the best out of the change in circumstances due to the COVID-19 outbreak.
- Communication levels increased and the desire to meet the project requirements still remained as a top priority.

Summary

- The team found the variation in measurements are due to the wear and tear of the shearing machine through D.O.E and Process Capability studies.
- The team accomplished to find a solution which is the string potentiometer

Team & Acknowledgements

- Edgar Rodriguez - Engineering Technology
- Jason McMillan - Engineering Technology
- Waleed Ahmed – Electrical Engineering
- Mark Hogan - Electrical and Computer Engineering Technology

Mentor: Wes Stone - BSET Program Director
Sponsor: Caleb Kiser - Engineer OMG Edge Systems