PRODUCTIVITY AND QUALITY IMPROVEMENT OF COMMERCIAL VEHICLES CRANK BORE FINISHING USING SPC CHARTS

RAJESH.S[1] AND GOPI.S[2]

[1]Assistant Professor, Department of Mechanical Engineering

[2] Student, Department of Mechanical Engineering

ABSTRACT: - Excessive variability in any process performance often results in waste and rework. For improvement in quality and productivity, process variation needs to be reduced. For this Statistical Process Control techniques are used. SPC uses statistics to detect variations in the process so that it can be controlled. Control charts are used in SPC for measuring the variation in the process and that can be continuously improved by the different techniques used in the SPC such as 7 Quality Control tools. This paper suggests the improvement of the process performance of the roughing and finishing operations on Crank bores of a Daimler 6-D cylinder block through the use of SPC, makes a brief review of concepts related with the methodology and aims to demonstrate all the advantages associated with its use as a method for improving quality and reducing waste.

KEY WORDS: *Cause and effect diagram, control charts, process capability index, SPC, Quality Control*

1. INTRODUCTION

Today, in the competitive market of automobile industries cost and quality are one of the important factors in determining the supremacy of a company. Far gone are the days where monopoly of a company in a particular sector lead to it control over the market. With new emerging technologies and innovative young minds individual dictatorship is highly unlikely. So companies main focus has been customer satisfaction and quality. Quality is defined as standard of something as measured against other things of a similar kind or degree of excellence of something. Unsatisfactory quality is non-expectable by the consumer as well the manufacturer. This change in quality may be due to a number of factors most important being variation in a certain process.

A variation in a process is defined as a change or slight difference in condition, amount, or level, typically within certain limits. The variation in the quality of product in any manufacturing process are due to two reasons, Chance causes and Assignable causes. A process with only chance causes is said to be in a state of statistical control. This means, chance causes results in only minor variation in the process whereas assignable causes results in major variation in a process. Therefore, the main aim of SPC is to identify and rectify the assignable causes as soon as possible for an acceptable quality as per industrial standards[ii]

1.2 SPC -IMPLEMENTATION STEPS

Establish an environment suitable for action–Top management must help build an environment that promotes proper action and support to the information collected on the control charts.

1) Define the process–Techniques such as Process Mapping and Process Flow

charts can be used to define the process. This is important to understand the process in terms of its relationship to other operations and users, both upstream and downstream, and in terms of process elements (Man, M/c, Material, Method & Environment).

2) Determine Characteristic to be charted– To determine the characteristic, several considerations such as critical characteristics, characteristics affecting regulatory requirements and customer's needs, characteristics involved in current and potential problems areas, characteristics for high volume components.
3) Defining the measurement system–Data collected from the process is validated through the use of a CAPABLE measurement system. This involves specifying what information is to be gathered, where, how and under what conditions. The measurement equipment itself must be predictable for both accuracy and precision.
4) Minimize unnecessary variation– Unnecessary external causes of variation should be reduced before the study begins. The purpose is to avoid obvious problems that could and should be corrected even without use of control charts.

2. METHODOLOGY

Firstly, SPC is applied to analyze the defect rate using the seven quality control tools.

Step 1: Capability checking by using the control charts for the collected readings.

Step 2: Check the result, the process is not capable or not.

Step 3: If the process is not capable the find out the root cause analysis for the result and the find the reason for problem occur.

Step 4: To take corrective plans and implementation**.**

3.1 PROCESS CAPABILITY CHECKING

Table 1.1 Daimler 6d Cylinder Block Crank Bore Diameter Inspection

USL				**91.022**	
LSL				**91.000**	
SAMPLE FREQUENCY				**50**	
PARAMETER				**CRANK BORE DAIMLER**	
n	**X1**	**X2**	**X3**	**X4**	**X5**
1	**91.009**	**91.007**	**91.006**	**91.007**	**91.006**
2	**91.009**	**91.007**	**91.006**	**91.007**	**91.006**
3	**91.008**	**91.006**	**91.006**	**91.006**	**91.006**
4	**91.008**	**91.006**	**91.005**	**91.006**	**91.005**
5	**91.007**	**91.006**	**91.005**	**91.006**	**91.005**
6	**91.007**	**91.006**	**91.008**	**91.006**	**91.008**
7	**91.006**	**91.005**	**91.007**	**91.005**	**91.007**
8	**91.006**	**91.005**	**91.008**	**91.005**	**91.008**
9	**91.006**	**91.005**	**91.006**	**91.005**	**91.006**
10	**91.006**	**91.005**	**91.006**	**91.005**	**91.006**
X BAR	**91.007**	**91.005**	**91.006**	**91.005**	**91.006**
R BAR	**0.003**	**0.002**	**0.003**	**0.002**	**0.003**

(All Dimension are in mm)

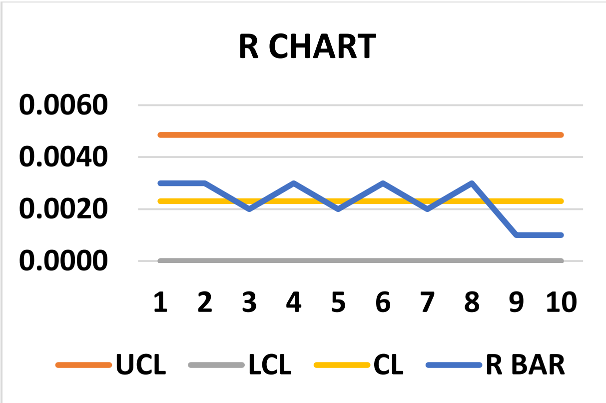

Fig.3.1 R Bar Chart

3.2 CALCULATION OF PROCESS CAPABILITY

Table 1.2 Calculation of Process Capability

FORMULA		BEFORE USING SPC	AFTER USING SPC
Tolerance (t)	**USL - LSL**	**0.0220**	**0.0220**
Actual sigma s	**Sq. Rt. Of {(SXi²-XBar²)/(n-1)}**	**0.0018**	**0.0010**
Estimated sigma	**R BAR / d2**	**0.0011**	**0.0010**
C_P	**T/6σ**	**3.2803**	**3.7081**
C_{PK}	**min** (C_{PKU}, C_{PKL})	**1.1093**	**2.0968**
P_P	**T / 6S**	**2.0951**	**3.5396**
P_{PK}	**min** $(P_{PKU}, P_{PKL}$	**0.7085**	**2.0015**

4. RESULT AND DISCUSSION

Table 4.1 Difference between existing and implementation

Existing work condition	**Optimized work condition**
✓ SOEX 09 04 08 01 insert grade BK61 used form SOP	✓ SPKX 090406 insert grade LCG10T. ✓
✓ It has a tool life of 60 *Nos.	✓ It has a tool life of 85 *Nos.
✓ Tool is set at maximum of tolerance range during insert change & adjustment is done only when minimum of tolerance range is reached.	✓ Tool is set at 80% of tolerance range & adjustment is done when 20% of tolerance range is reached.
✓ *C_{PK} – 1.11	✓ *C_{PK} – 2.10
✓ *P_{PK} – 0.71	✓ *P_{PK} – 2.00
✓ Process NOT CAPABLE	✓ Process CAPABLE

- ✓ Tool life has increased by 25 *Nos which is about 41.66% of higher life expectancy than the existing tool life.
- ✓ The time between intermittent tool changes is increased thus decreasing in lead time of production.
- ✓ Process Capability Index (C_{PK}) and Process Performance Index (P_{PK}) values have been improved. The process has become capable.

5. CONCLUSION

This project traces the SPC approach for improving the process capability levels of the roughing and finishing operation of the crank bores. The Quality Control tools predominantly used for tracing out the causes for poor process performance are the cause and effect diagram (Ishikawa diagram), physical mechanism analysis and the failure modes and effects analysis. The process monitoring charts are employed at the workplace for monitoring the process performance and preventing it from deviations. Finally, on eliminating the causes one-by one, the process performance capability index (C_{PK}) improved from 1.11 to 2.10.

- ✓ Based on our findings, we recommend as follows:

- ✓ In this case, we suggest to use SPKX 090406 insert grade LC2401 tool life of 85 Nos as tool insert instead of using SOEX 09090801 insert grade BK61 which has a low tool life of 60 Nos.

For every insert change, tool is set at 80% of tolerance range & adjustment is done when 20% of tolerance range is reached instead of the previous setting where the tool is set at maximum of tolerance range during insert change & adjustment is done only when minimum of tolerance range is reached.

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