Vol II Issue VIII Feb 2013

Impact Factor : 0.1870

ISSN No :2231-5063

Monthly Multidisciplinary Research Journal

Golden Research Thoughts

IMPACT FACTOR : 0.2105

Welcome to ISRJ

RNI MAHMUL/2011/38595 **ISSN No.2230-7850**

Indian Streams Research Journal is a multidisciplinary research journal, published monthly in English, Hindi & Marathi Language. All research papers submitted to the journal will be double - blind peer reviewed referred by members of the editorial Board readers will include investigator in universities, research institutes government and industry with research interest in the general subjects.

International Advisory Board

Editorial Board

Address:-Ashok Yakkaldevi 258/34, Raviwar Peth, Solapur - 413 005 Maharashtra, India
Cell : 9595 359 435, Ph No: 02172372010 Email: ayisrj@yahoo.in Website: www.isrj.net

Golden Research Thoughts
Volume 2, Issue. 8, Feb. 2013
ISSN:-2231-5063
Available online at www.aygrt.net

ORIGINAL ARTICLE

PROCESS CAPABILITY STUDY IN MANUFACTURING OF MECHANICAL SEAL

SAMADHAN D. BHOSALE , S.C.SHILWANT AND S.R.PATIL

PG Student (Department of Mechanical Engineering),
Sinhgad Academy of Engineering, Pune.
Professor (Department of Mechanical Engineering),
Sinhgad Academy of Engineering, Pune.
Assistant Professor (Department of Mechanical Engineering),
Sinhgad Academy of Engineering, Pune.

Abstract:

The performance of mechanical seal in automobile manufacturing is vital. A mechanical seal is dynamic working seal, sealing an application with stationary housing & rotating shaft. Purpose of mechanical seal is to separate two or more media.

Variation exists in all processes & some jobs are rejected during manufacturing of mechanical seals. Process capability study enables the user to identify variation within the process. In this paper the process capability of critical parameters in manufacturing compact type mechanical seals applicable in pumps has been analyzed. Statistical tools were used to study process capability. Process capability of critical parameters was improved by 0.79 to 1.74.

KEY-WORDS:

Process Capability, Mechanical Seal, Process Stability, Control Chart, Specification.

INTRODUCTION

Process capability is measure of inherent variation of the process when it is in stable condition. It is important concept for industry to implement. Because in today's competitive market manufacturers are producing high quality products at minimum cost. This cannot be done without a systematic approach & process capability study.

Because of process capability study engineer can quantify how well process can produce acceptable product. If process need improvement we can make improvement in it. Process capability indices are used in manufacturing industry to determine whether a process is capable of producing items within specification limit or not.

A control chart is a statistical tool used to distinguish between variation in a process resulting from common causes and variation resulting from special causes. It helps to monitor the behavior of process graphically to determine whether it is stable. A Stable process is one that is consistent over time with respect to center & the spread of the data. It is Process in which variation arises only due to common causes. It is predictable because it is in control. Capable process must be stable. Process variation (spread) must be smaller than specification tolerance & Data should follow normal distribution.

Specification limits describe requirements for products, while acceptance limits are decisive factor in production. To assure quality we generally tighten the acceptance limit.

Title : PROCESS CAPABILITY STUDY IN MANUFACTURING OF MECHANICAL SEAL Source:Golden Research Thoughts [2231-5063] SAMADHAN D. BHOSALE , S.C.SHILWANT AND S.R.PATIL yr:2013 vol:2 iss:8

LITERATURE REVIEW

Mechanical Seals have been manufactured by various methods & in modern era due to advances in manufacturing the rejection of mechanical seal has become an important factor. The study shows that M Suozzi [1] has given a detailed procedure for analysis of Process Capability & control charts.

Alan Bowman, Josef Schmee [2] studied sensitivity of process capability of outputs to changes to input parameters. Authors analyzed the parameters which estimate the process capability with several examples.

Matti Mottonen, Pekka belt, Janne Harkonen [3] highlighted the problems of tightening the specification limits. Authors analyzed, through simulation and reduced the failure cost by adjusting the acceptance limits.

Maiziirwan Mel, Mohd Azmir Arifin , Mohd Hider Kamarudin, Mohamed Ismail Abdul Karim & Faridah Yusof [4] studied the six sigma limits and reduced the noise by applying Taguchi's design of experiment to improve process capability in microbiology.

The above review shows how statistical tools can be applied to improve the process capability of mechanical seal under study.

STATISTICAL TOOLS

Process Capability

Process Capability Index (Cp)

It is process capability index that indicates the process potential performance by relating the natural process spread to the specification spread. Cp is defined as the ratio of specification width over the process spread. Specification width depends upon the customer requirements. If process variation is large, process capability will be on lower side. [1]

$Cp = \text{specification range} / 6\sigma$
$= USL-LSL / 6\sigma$

Process Capability Index (Cpk)

This is process Capability index that indicates the process actual performance by accounting for a shift in the mean of process toward either the upper or lower specification limit. The larger the index, the less likely it is any parameter will be outside the specifications.

$Cpk = \text{Min}(USL-Mean/ 3\sigma, Mean-LSL/3\sigma)$

The use of Cp & Cpk assumes the process output to be normally distributed & process variation to be symmetrical. If Cp and Cpk is greater than 1.33 then process is said to be within acceptable capability.

Control Chart

A control chart is a statistical tool used to distinguish between variation in a process resulting from common causes and variation resulting from special causes. It presents a graphic display of process stability or instability over time.

Every process has variation. Some variation may be the result of causes which are not normally present in the process. This could be special cause variation. Some variation is simply the result of numerous, ever-present differences in the process. This is common cause variation. Control Charts differentiate between these two types of variation. One goal of using a Control Chart is to achieve and maintain process stability. [2,3,4]

Process Stability

Process stability is defined as a state in which a process has displayed a certain degree of consistency in the past and is expected to continue to do so in the future. This consistency is characterized by a stream of data falling within control limits based on plus or minus 3 standard deviations (3 sigma) of the centerline.

METHODOLOGY FOR PROCESS CAPABILITY

A detailed study was made at EKK Eagle Products India Pvt. Ltd, Pune for improvements of process capability of manufacturing of compact type mechanical seal. It was decided to select the parameters from previous design data by the company.

Following parameters were checked from drawings,

1)Cartridge O.D.
2)Load of Mechanical seal
3)Seal Ring Roughness
4)Seal Ring Height
5)Sleeve + Mating Ring width
6)Sleeve + Mating Ring parallelism

Critical parameters were selected before process capability study and were established from drawings. By testing & monitoring the above parameters of mechanical seal & based on the function of the mechanical seal, the following critical parameters were selected.

1) Load of Mechanical seal: Specification of Load of mechanical seal is 19.6-26 N. and it is set by company.
2)Seal Ring Roughness: Specification of Seal Ring Roughness is 0.01-0.10 µm and it is set by company.
3)Seal Ring Height: Specification of Seal Ring Height is 1.00-1.40 mm and it is set by company.

Table1. shows Cp & Cpk for critical parameters.

Table 1: C_p & C_{pk} for critical parameters

Parameter	Load of Mechanical seal	Seal Ring Roughness	Seal Ring Height
Specification	19.6-26.0 N	0.01-0.10 µm	1.00-1.40 mm
C_p	1.75	1.12	2.16
C_{pk}	1.69	1.01	1.97

ANALYSIS OF CRITICAL PARAMETERS

Process Capability analysis from control charts

Control charts are useful to monitor the process after initial process capability evaluation. Periodic re-evaluation is also necessary. Control charts may be used to get standard deviation and process mean.

For control charts, (UCL)Xbar , (LCL)Xbar , (UCL)R, (LCL)R were calculated by taking readings of samples in 25 subgroups which covered entire one shift. From control chart, process capability was calculated using formulae & to improve process capability, major common causes were found out and removed; also changes in the process were carried out.

Xbar & R chart are shown in figure1& 2 for critical parameters- load of mechanical seal & Seal Ring height. For load of mechanical seal the specification was 19.6-26 N & load of mechanical seal was measured on load measurement machine. Similarly for seal ring height the specification was 1.2±0.2 mm and seal ring height was controlled on finish grinding machine.

To improve process capability of load carrying capacity of mechanical seal, changes in Seal Ring height were made. To improve process capability of Seal Ring roughness, changes in speed of grinding wheel as well as changes in lapping frequency of grinding wheel were made. To improve process capability of Seal Ring height, changes in speed of grinding wheel and changes in grinding wheel height were made.

By using statistical tools Cp & Cpk for critical parameters were improved. Analysis shows:

1)Cp & Cpk for load carrying capacity of mechanical seal was improved by 1.08 & 0.96 respectively.
2)Cp & Cpk for Seal ring roughness was improved by 1.74 & 1.13 respectively.
3)Cp & Cpk for Seal ring height was improved by 0.79 & 0.80 respectively.

CHARTS & TABLES

X bar and R control chart for load carrying capacity & seal ring height were studied. Assignable variations were removed as discussed earlier and significant changes in Cp & Cpk were noted. Figure 1 & 2 show the process being within control limits, Tables 1 & 2 shows the improvement in Cp & Cpk for the critical parameters of the mechanical seal. Once the process was made stable periodic revaluation of these parameters were done.

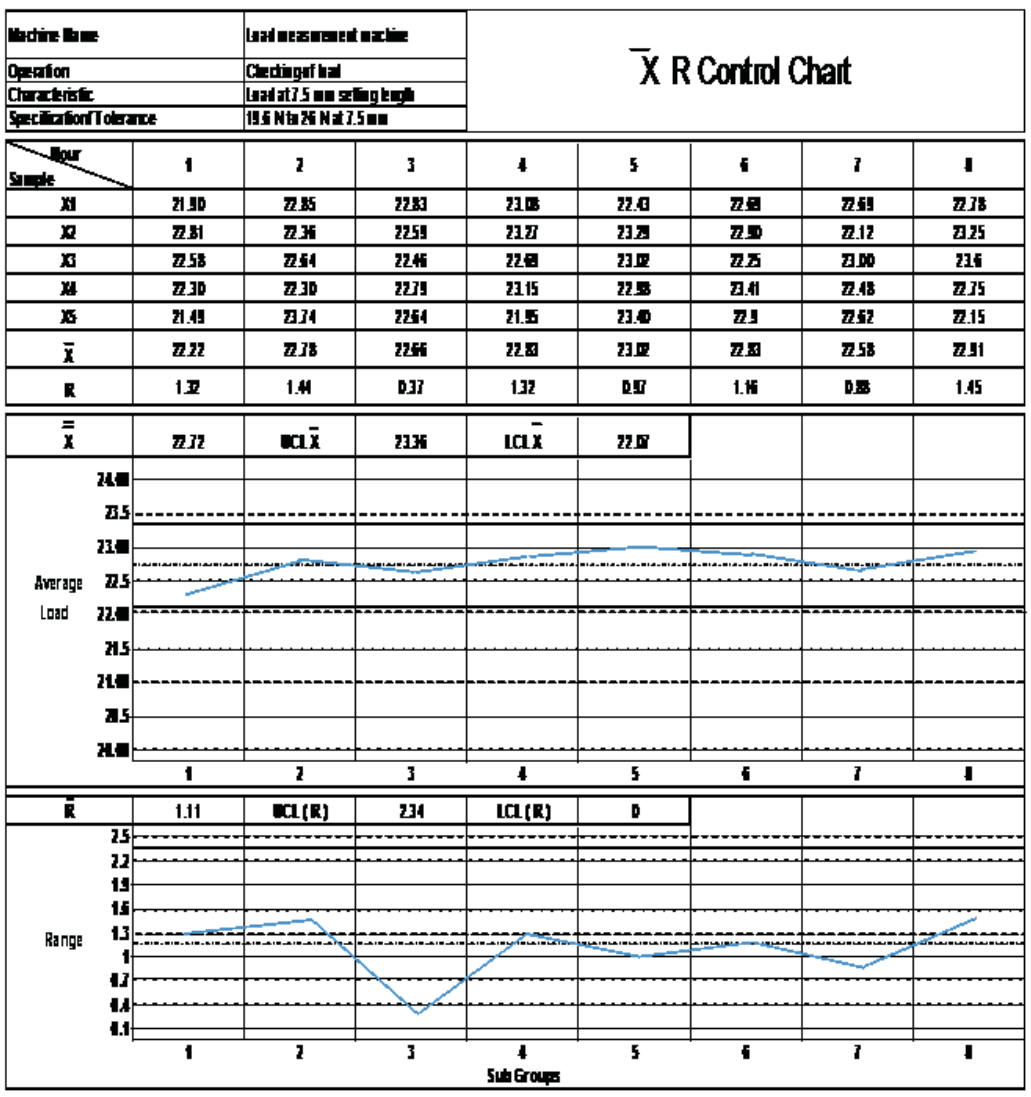

Figure 1: X bar R control chart for load carrying capacity of mechanical seal

The figure illustrates natural process limits controlled within specification limit.

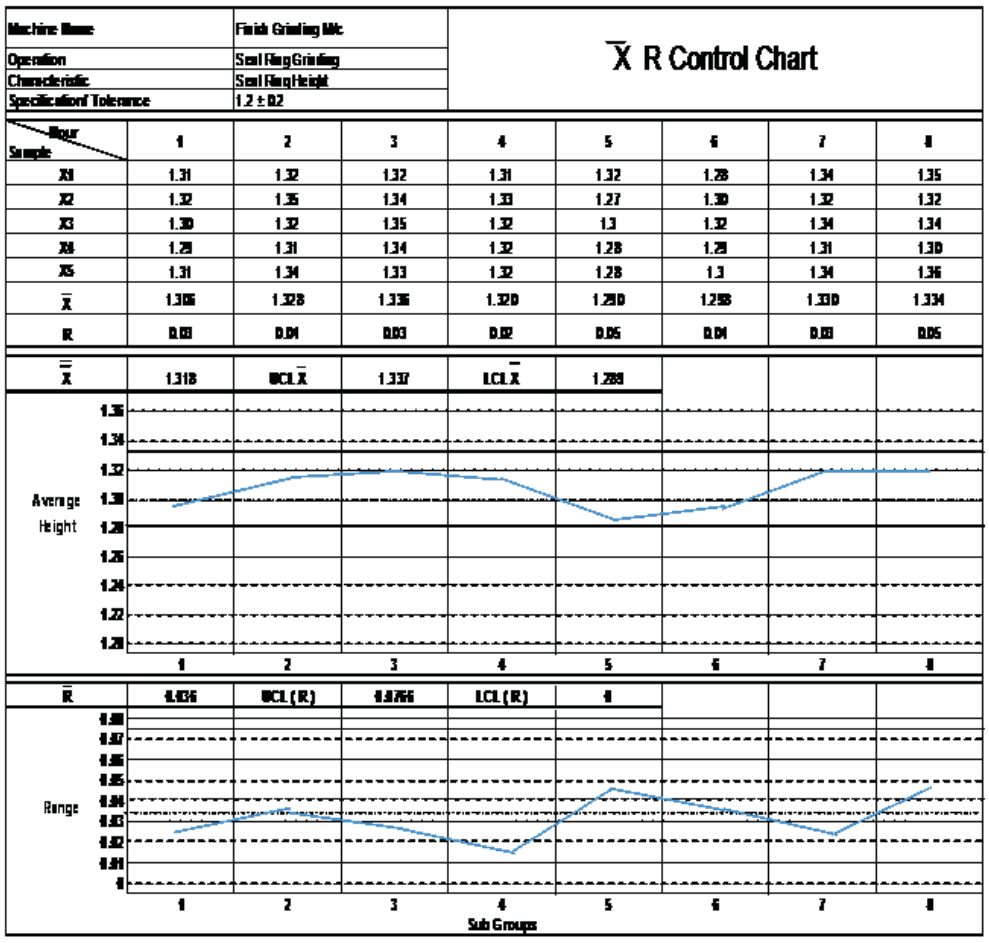

Figure 2: X bar R control chart for Seal Ring height

Figure illustrates the improved process capability.

Table 2: Improved C_p & C_{pk} for critical parameters

Parameter	Load of Mechanical seal	Seal Ring Roughness	Seal Ring Height
Specification	19.6-26.0 N	0.01-0.10 µm	1.00-1.40 mm
C_p	2.83	2.86	2.95
C_{pk}	2.65	2.14	2.77

CONCLUSION

Process Capability index can be used as process performance indicator in manufacturing industry. Cpk is indirectly related to percentage of non conforming product. To achieve desired quality of product control limits can be tightened.

This study confirms that using control charts and by making changes in processes, we can make processes stable. By controlling process parameters and specification limits we can achieve quality but decisions

should be made on economic basis.
Process Capability can be effectively used to improve Cp & Cpk.
Cp & Cpk was improved for load carrying capacity of mechanical seal by 1.08 & 0.96 respectively.
Cp & Cpk was improved for Seal ring roughness by 1.74 & 1.13 respectively.
Cp & Cpk was improved for SR height by 0.79 & 0.80 respectively.
Further study on effect of dynamic changes of critical parameters can be studied.

The authors thank EKK Eagle Products for the help in carrying out the analysis.

REFERENCES

[1] M. Suozzi, 1990, "Process capability studies" member of the technical staff, Hughes Aircraft Company, Tucson, Arizona.
[2] Alan Bowman, Josef Schmee, 2011, "Shift, narrow & chip to improve process capability" Union Graduate college, 80 Nott Terrace Schenectady, NY, 12308, USA
[3] Matti Mottonen, Pekka Belt, Janne Harkonen, Harri Haapasalo & Pekka kess, 2008, "Manufacturing Process capability & Specification limits" Department of Industrial Engineering & Management, University of Oulu, Finland.
[4] Maiziirwan Mel, Mohd Azmir Arifin, Mohd Hider Kamarudin, Mohamed Ismail Abdul Karim & Faridah Yusof, 2011, "Simple process capability analysis and quality validation of monoclonal antibody production in benchtop bioreactor" Bioprocess & Biomolecular Engineering Research Unit (BPMERU), Kuala Lampur, Malaysia.
[5] Frank M. Gryna, Richard C.H. Chua, Joseph A. Defeo, "Juran's Quality Planning & Analysis for Enterprise Quality" Tata McGraw-Hill Education Private Limited, Fifth Edition.
[6] Eugene L. Grant, Richard S. Leavenworth, "Statistical Quality Control" Tata McGraw-Hill Education Private Limited, Seventh Edition.