

24 PROCESS CAPABILITY STUDIES

Description

Process Capability Studies statistically evaluate the ability of a process to hold a product feature or set of features to within their dimensional limits.

Purpose

The functionality and reliability of products depend on the accuracy to which their important features are manufactured. Process capability studies measure, in statistically defined terms, the accuracy of these features with respect to the limits imposed.

Benefits

When a product's key manufacturing process capability studies are performed and the ability of its processes to conform to their dimensional limits is established, confidence in the functionality and reliability of the product is greatly enhanced. Moreover, the most critical features can have the most stringent criteria imposed, allowing optimum manufacturing resource allocation.

Implementation

To gain maximum benefit from process capability studies, the criticality of component features must be established through 8D analysis, FMEA, Fault Tree Analysis, and product testing. Once feature criticality is prioritized, manufacturing resource allocation can be applied by priority. The most stringent criteria can be assigned to the most critical features.

A Measurement Systems Analysis (MSA) must precede the capability study to ensure that the gauging system is appropriate.

Control Plans must define the process being measured and reflect the measurement system and process used.

The effectiveness of process capability studies is closely linked to the knowledge established relating criticality of features to product functionality and reliability.

Process Flow

1. Define the product feature tolerance requirements, by design guidelines, FMEA, Fault Tree Analysis, 8D analysis, lab and field-testing.

2. Define the product feature capability requirements, by methods as in step 1.
3. Define the measurement approach, variable or attribute.
4. Define the measurement system.
5. Define/Evaluate the control plan.
6. Perform a Measurement Systems Analysis.
7. Perform an appropriate process capability study according to the *QS 9000 Manual – Process Capability Studies*.
8. Document the results in the Quality System.
9. Improve the process as required.

Example

By warranty-driven seal leakage 8D analysis, the output seal diameter in the rear bearing cover in a heavy-duty transmission was identified as significant to quality. This feature is defined as a diameter dimensioned as 4.502/4.498, based on design studies and durability testing. The requirement for a feature with this “significant to quality” designation is defined as 1.33 Cpk for a variable measurement. Since this feature is measured with a variable gage, an MSA was performed to establish an 8percent R and R and a 7percent precision to tolerance ratio for those gauges, which was deemed acceptable. A process capability study was performed on 30 pieces. A statistical analysis showed the capability of 2.26 Cpk.

Process Capability Analysis for RBC diameter

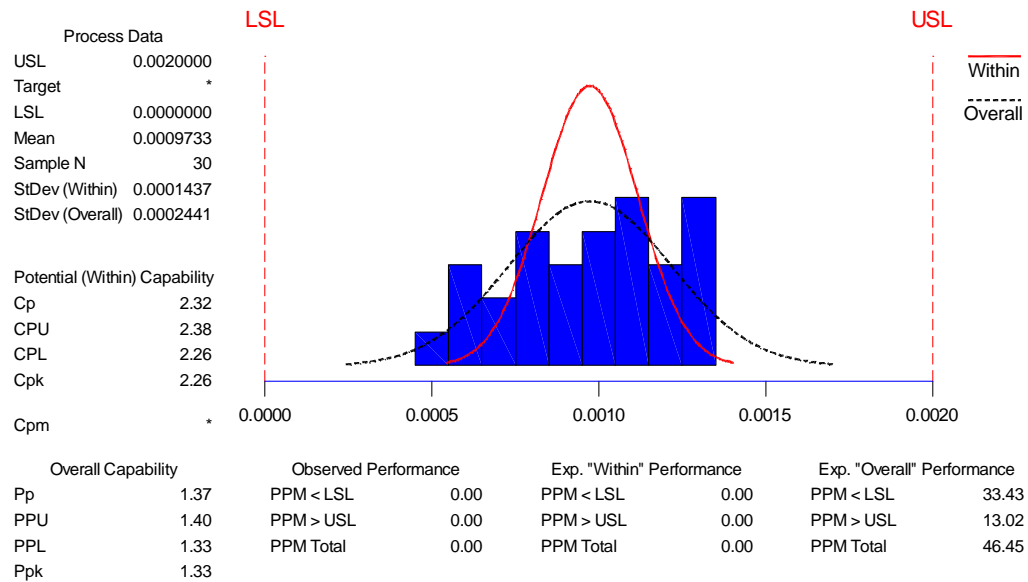


Figure 24.1. Process Capability Analysis

Table 24.1. Measurements taken with a dial bore gage and recorded by the operator on a rainbow chart

0.0006	0.0005	0.0010
0.0010	0.0006	0.0011
0.0011	0.0008	0.0013
0.0012	0.0011	0.0011
0.0013	0.0012	0.0010
0.0013	0.0013	0.0009
0.0012	0.0011	0.0008
0.0010	0.0009	0.0007
0.0008	0.0007	0.0008
0.0006	0.0009	0.0013

General Comments

Process capability studies are an integral part of Phase 3 – Process Design and Development.

References

AIAG. *SPC Manual*, 3rd Edition.