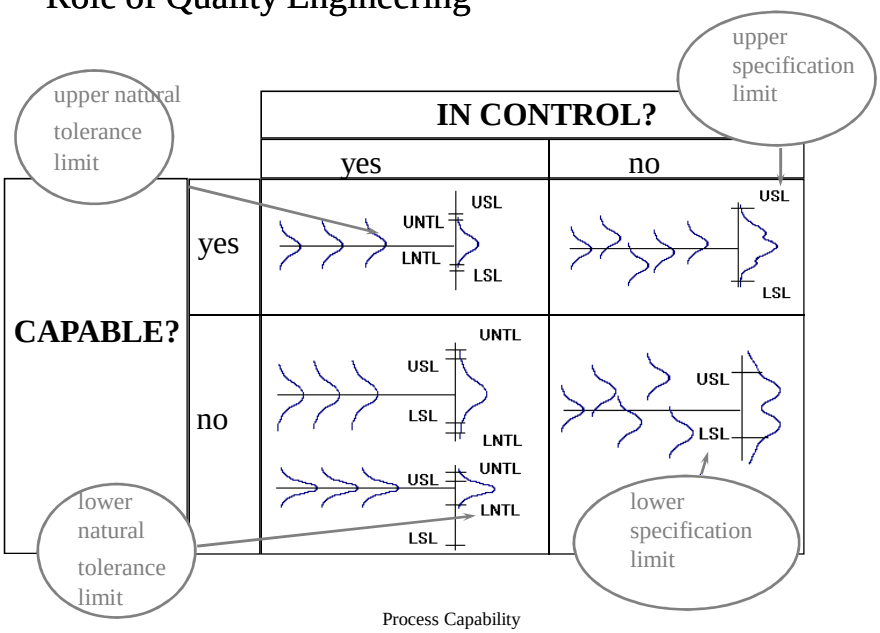
PROCESS CAPABILITY

Role of Quality Engineering



Analysis of process capability

Process capability index (Potential capability)

$$C_P = \frac{USL - LSL}{6\sigma}$$

Example 1

In a manufacturing process the expected value of a quality characteristic is 250.727 unit, the standard deviation is 1.286 unit. The specification is 250.5 unit.
How much is the proportion of defectives in this process?
Calculate the C_P capability index!

$$z_{\text{upper}} = \frac{USL - \mu}{\sigma} = \qquad P(x > USL) =$$

$$z_{\text{lower}} = \frac{LSL - \mu}{\sigma} = \qquad P(x < LSL) =$$

$$C_P = \frac{USL - LSL}{6\sigma}$$

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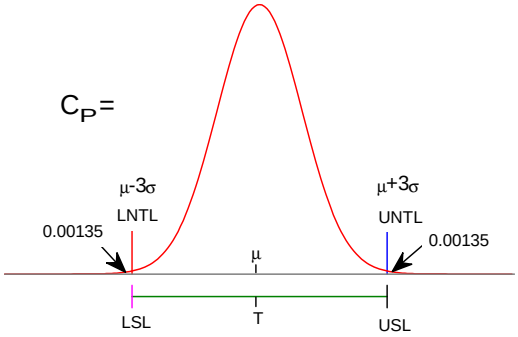

Process Capability

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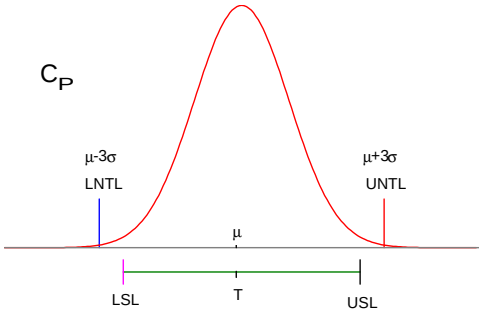

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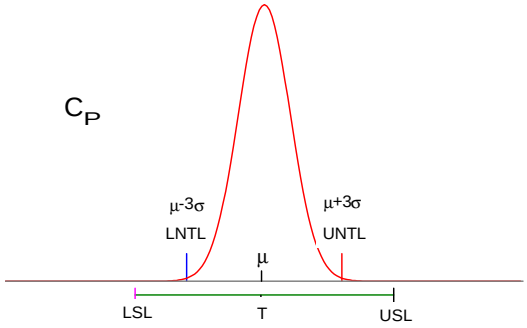
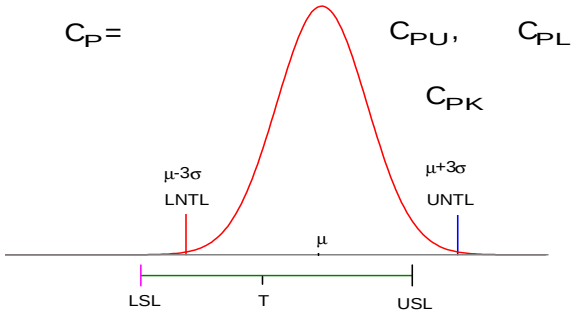


Corrected indices (demonstrated capability)

$$C_{PU} = \frac{USL - \mu}{3\sigma}; \quad C_{PL} = \frac{\mu - LSL}{3\sigma}; \qquad C_{PK} = \min(C_{PU}, C_{PL})$$



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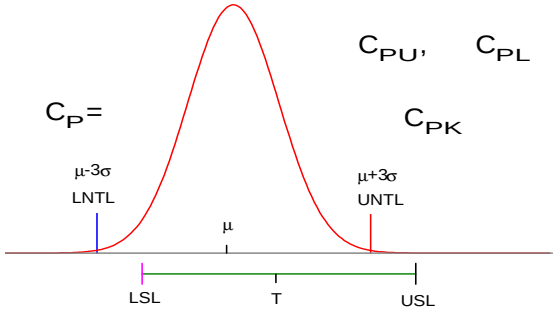


$$C_P = \frac{USL - LSL}{6\sigma}$$

Modified process capability index

capability index

$$C_P = \frac{USL - LSL}{6\sigma}$$

modified capability index

$$C_{Pm} = \frac{USL - LSL}{6\tau} = \frac{USL - LSL}{6\sqrt{\sigma^2 + (\mu - T)^2}}$$

$$MSE = E\left[(x - T)^2\right] = \tau^2 \qquad \tau^2 = \sigma^2 + (\mu - T)^2$$

related to Taguchi's quadratic loss function

Example 2

Compare two processes, the specification for both is 100±1.

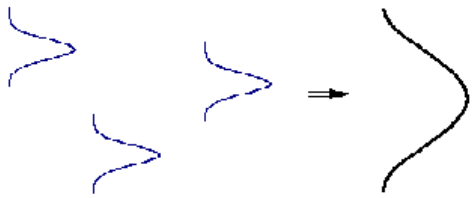
I. s =0.2, m=99.5, that is the center of fluctuation deviates from the nominal value

II. s =0.4, m =100, that is the center of fluctuation is the nominal value, but the fluctuation is larger

Example 3

The specification is 100±1, s =0.2. Calculate the capability indices and the proportion beyond specs (above *USL* or below *LSL),* if m is 100, 99.5 and 100.5!

Process capability and process performance (short term and long term)



$$C_P = \frac{USL - LSL}{6\sigma}$$

which σ?

σ_{ST}
(short term)

σ_{LT}
(long term)

Estimating variance from the within-samples (short term) changes refers the internal, random fluctuation C_P (potential capability)

Combining both within-samples and between-samples changes the long term fluctuation is considered P_P (process performance)

$P_P \leq C_P$

The process capability study is to be interpreted for in-control processes only.

Two parts of the task:

1. Stabilize the process for an acceptable time span, eliminating potential sources of fluctuation (e.g. operator, lot of raw material)

2. Compare the long term process performance with that expected

How to check stability?