Quality Management Course – Fall 2017

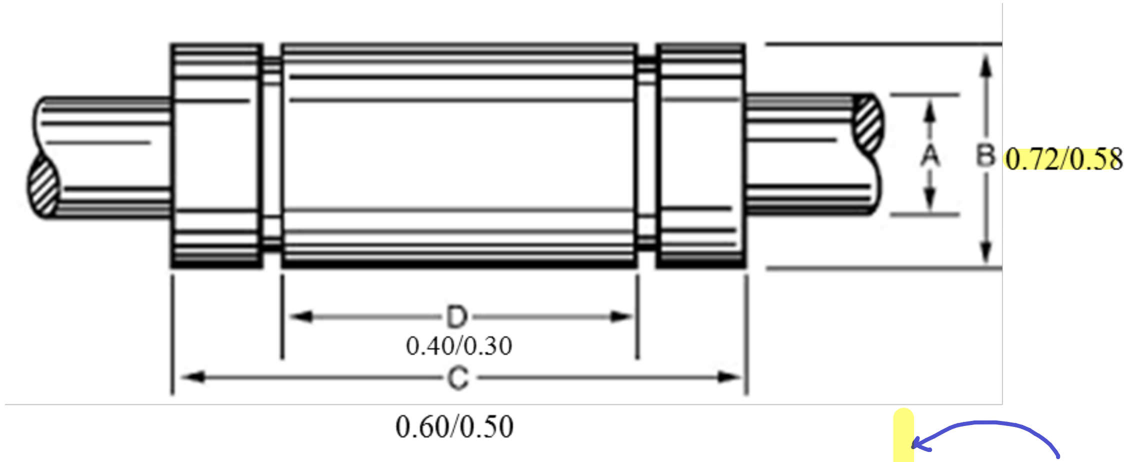
Chapter 7

Design for Quality and Product Excellence

Nominal Dimensions and Tolerance

see another example in the textbook page 327

* Allowable Range of the Dimension C = 0.60/0.50
* The Nominal (Target) Value = The midpoint = 0.55
* The specifications = 0.55±0.05



Product Tolerances and Specifications

$T = \frac{0.5 + 0.6}{2} = 0.55$

Specification = 0.55 ± 0.05

* $T = \frac{0.72 + 0.58}{2} = 0.65$

Specification = 0.65 ± 0.07

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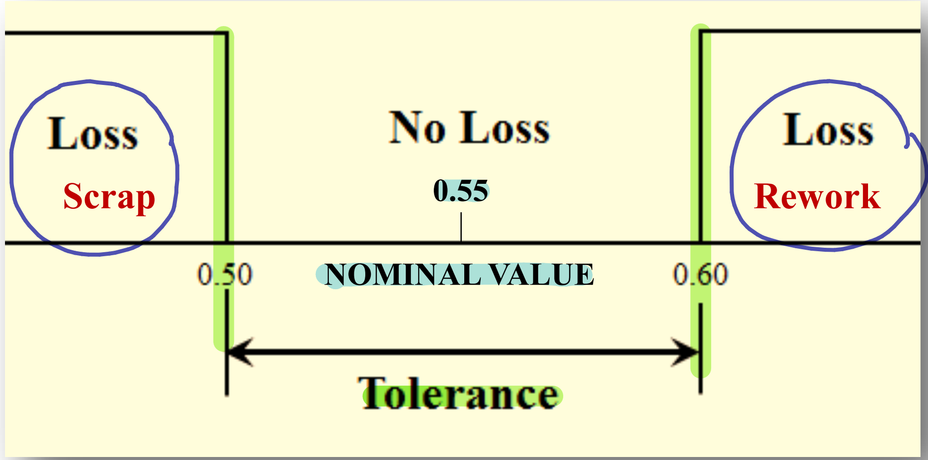
The TAGUCHI Loss Function see the textbook page 328 (revised)



Traditional way of economical view of conformance to specifications

QUESTION: What is the difference between 0.49 mm and 0.51 mm ?

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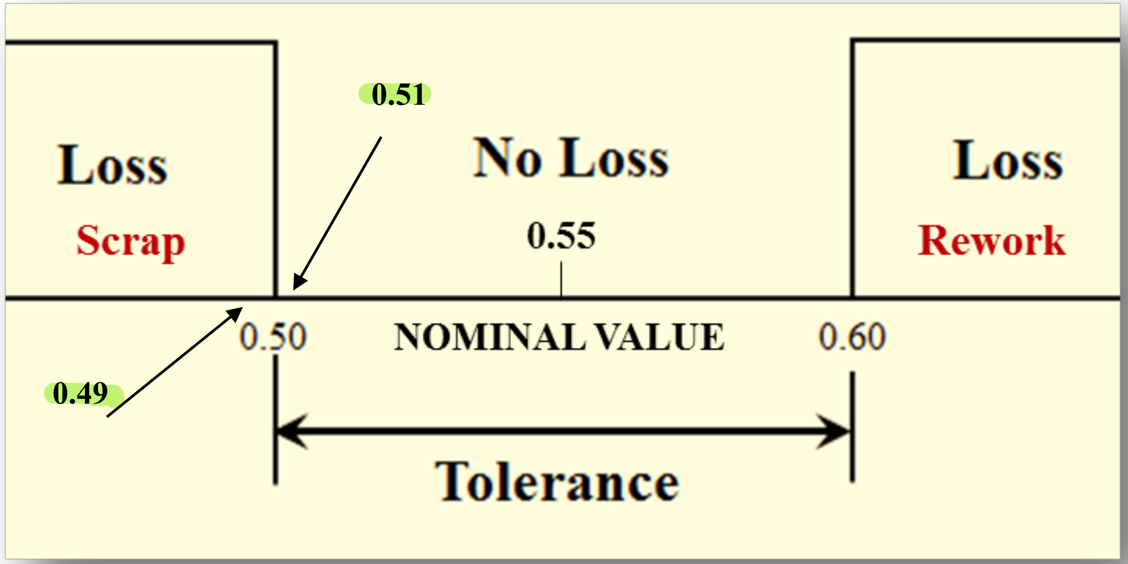
The TAGUCHI Loss Function see the textbook page 328 (revised)



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The TAGUCHI Loss Function see the textbook page 329

Real-World Case (Sony Television) see the textbook page 329

San Diego Plant → Within Specifications

Japan Plant → Out of Specifications

Average Loss in San Diego is $0.89 greater than Japan

WHY

1- The WORKERS adjust units that are out of specifications

2- Adjusted UNITS means more complaints from customers and then additional service cost

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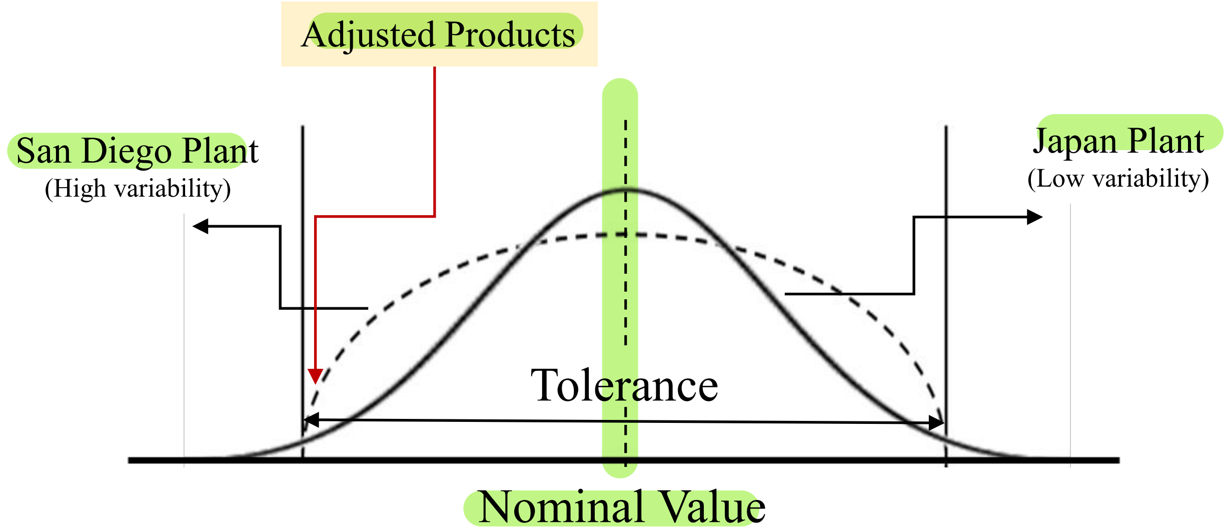
The TAGUCHI Loss Function see the textbook page 329

Real-World Case (Sony Television) see the textbook page 329



Sony Television Example (Textbook – Revised)

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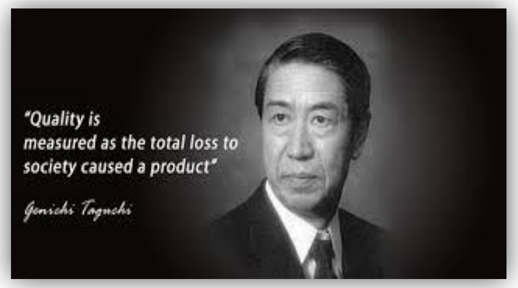
The TAGUCHI Loss Function see the textbook page 329

Loss Function?

- The **Loss Function** is the cost of variation into monetary terms.



- **Taguchi** measured the quality as the variation from the target value of design specifications.

Taguchi believes that larger deviation form the target values means larger losses

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The TAGUCHI Loss Function see the textbook page 329

How to Calculate Loss Function

CASE I: NOMINAL is the Better (or the BEST)

$$L(x) = k(x - T)^2$$

deviation

The LOSS increase by the square of the deviation from the target **T**

Where:
x is the actual value of the quality characteristic
k is a constant

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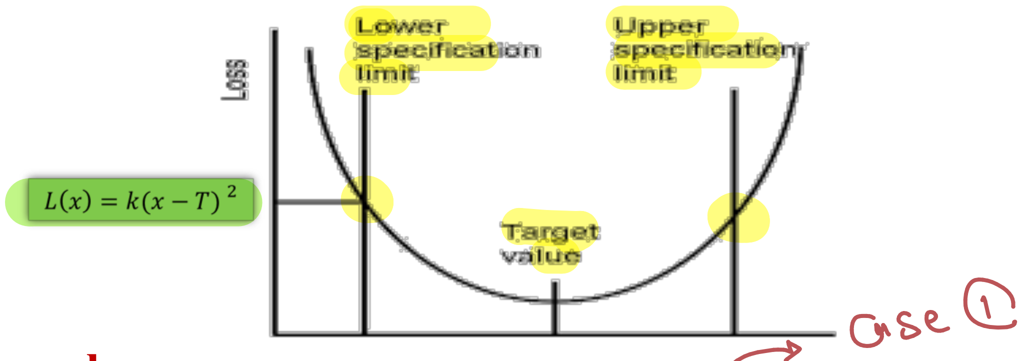
CASE I: NOMINAL is the Better (or the BEST)



Example: see the text book (another example)

- The specification limits are 0.55±0.05
- If the product exceeds the target value 0.55 by the tolerance of 0.05 on either sides, the product requires an adjustment and cost 10 $.

Solution

$T = 0.55$

$\rightarrow X = 0.55 + 0.05 = 0.6$

$L(0.6) = 10\$$

$L(x) = k(X - T)^2$

$10 = k(0.6 - 0.55)^2$

$k = 4000$

$L(x) = 4000(x - 0.55)^2$

Deviation $= X - T$

IF Deviation $= 0.02$ what $L = ??$

$X = 0.55 + 0.02 = 0.57$

$L(0.57) = 4000(0.02)^2$

$= 1.6\ \$$

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The TAGUCHI Loss Function see the textbook page 329

How to Calculate Loss Function

CASE II: Smaller is the Better (or the BEST)

$$L(x) = k x^2$$

The LOSS increase by the square of the current value of the quality characteristics

Where:

x is the actual value of the quality characteristic

k is a constant

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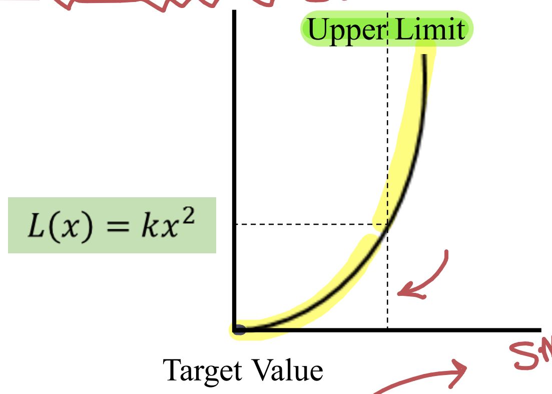
CASE II: **Smaller is the Better** (or the BEST)



Example:

- The upper specification limit is 0.70
- If the product exceeds the target value 0.50 by the tolerance of 0.20 on the right side, the product requires an adjustment and cost 50 $.

Solution

$T = 0.5$

$x = 0.5 + 0.2 = 0.7$

$L(0.7) = 50\ \$$

$L(x) = kx^2$

$50 = k(0.7)^2$

$k = 102.05$

$L(x) = 102.05(x)^2$

if current value $x = 0.75$

$L(0.75) = 102.05(0.75)^2$

$= 57.4\ \$$

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The TAGUCHI Loss Function see the textbook page 329

How to Calculate Loss Function

CASE III: Larger is the Better (or the BEST)

$$L(x) = k\left(\frac{1}{x^2}\right)$$

The LOSS increase by the square of the 1/the current value of the quality characteristics

Where:

x is the actual value of the quality characteristic

k is a constant

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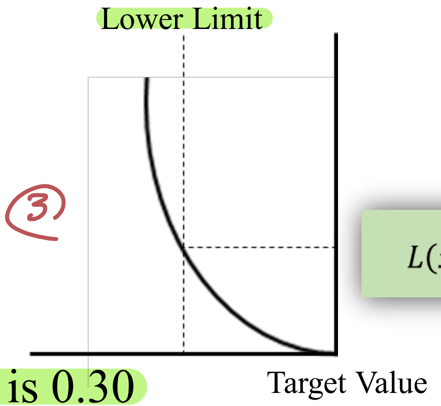
CASE III: Larger is the Better (or the BEST)



$$L(x) = k(\frac{1}{x^2})$$

Case 3

Example:

- The lower specification limit is 0.30
- If the product decreases the target value 0.40 by 0.10 on the left side, the product requires an adjustment and cost 70 $.

Solution

$T = 0.4$

$x = 0.4 - 0.1 = 0.3$

$L(0.3) = 70\ \$$

$L(x) = k(1/x^2)$

$70 = k\left(\frac{1}{0.3^2}\right)$

$k = 6.3$

then $L(x) = 6.3(1/x^2)$

the current value is 0.25

then

$L(0.25) = 6.3\left(\frac{1}{(0.25)^2}\right)$

$= 100.8\ \$$