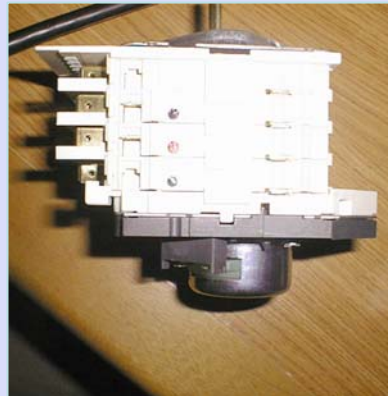
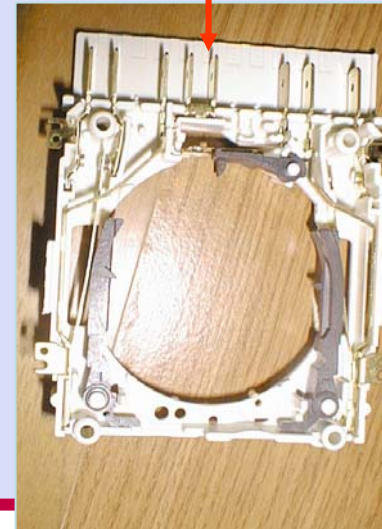
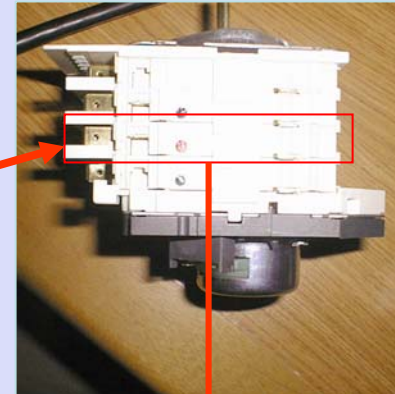


*EC Timer Box
Product Design for Six Sigma*



Application of Product



Customers: Whirlpool,
Bosch, AEG, and others

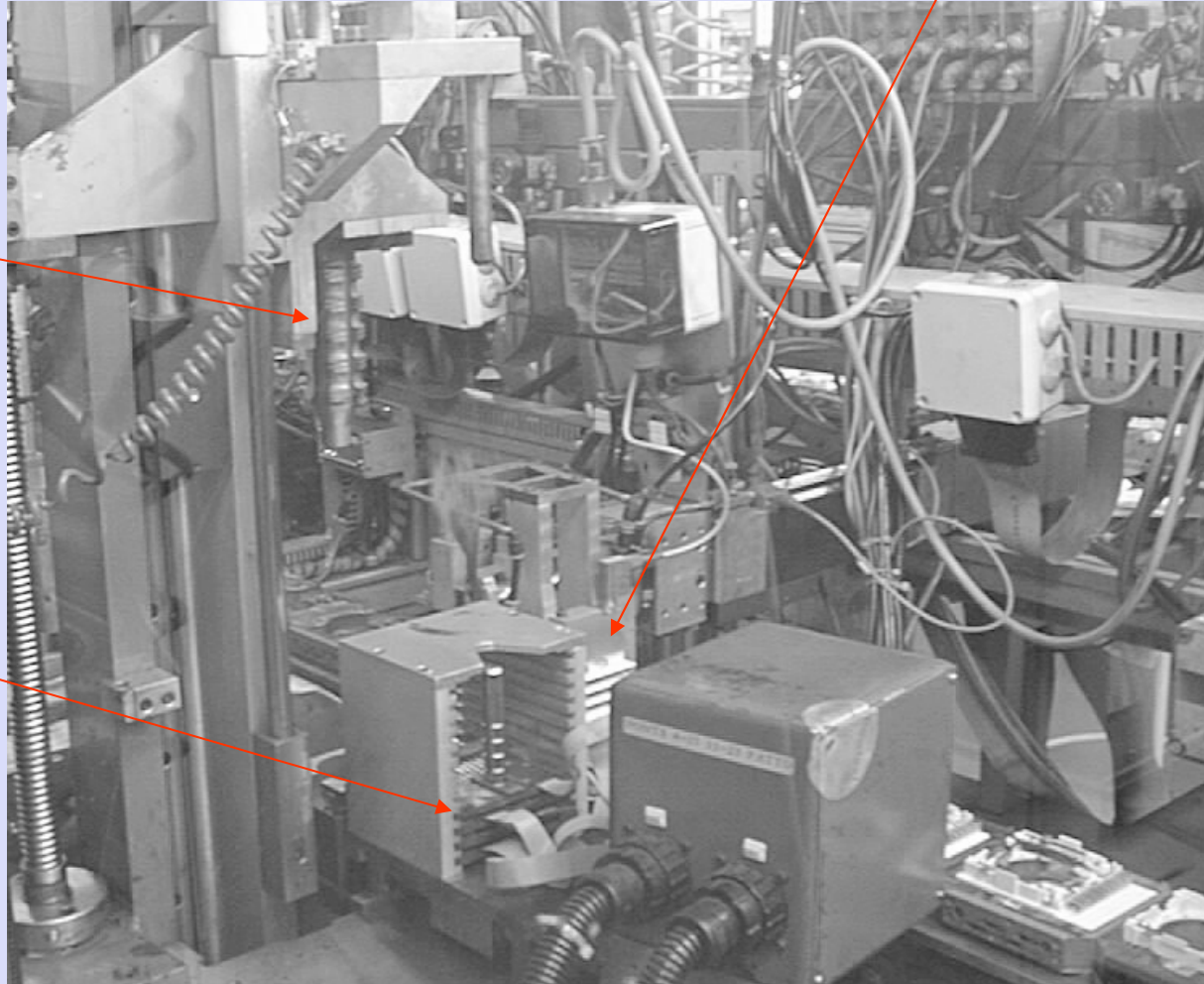
Goals

To Decrease the reject rate by a factor of 10 from 10% to less than 1%

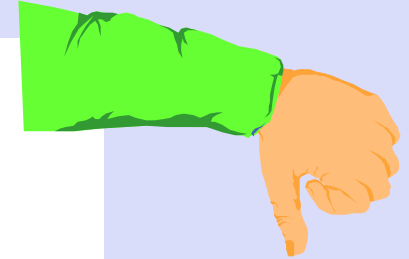
Test machine Layer
Stacker

Test
cam

Contact
springs



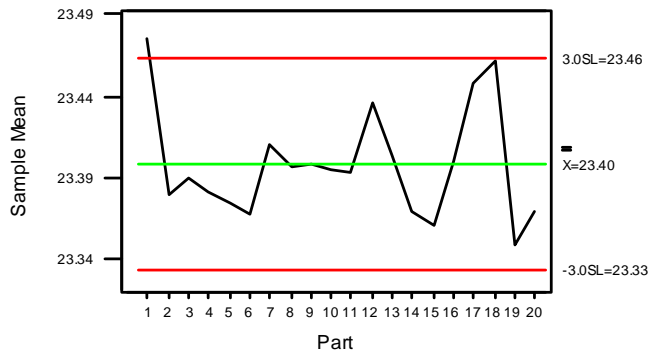
Gage R&R on Automatic test Rig Attempt 1



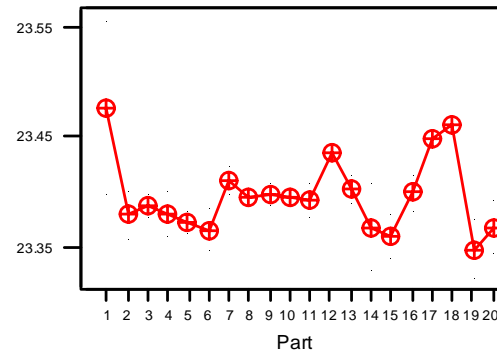
Gage R&R (ANOVA) for Value

Gage name: Automatic Test rig
 Date of study: 22/09/98
 Reported by: Switchbox team
 Tolerance: 0.5mm
 Misc: Test on switch 1a level 1

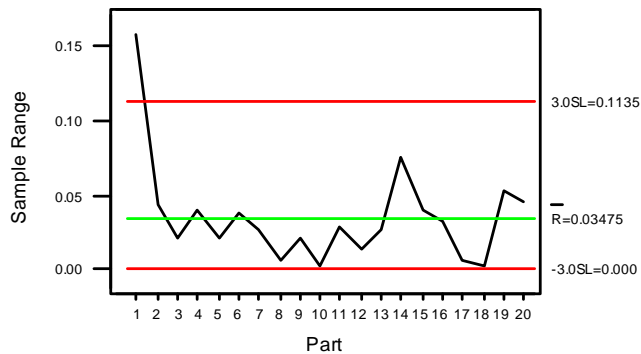
Xbar Chart



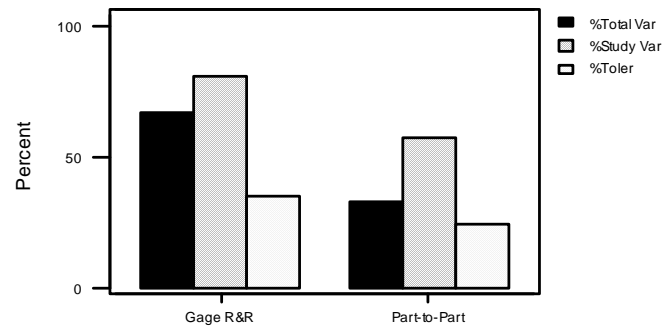
By Part



R Chart



Components of Variation

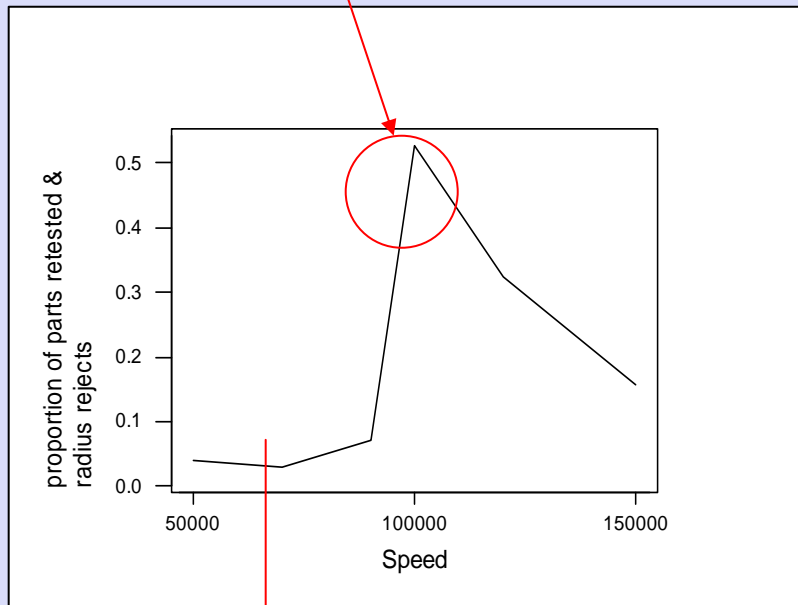


To Make a Long Story Short....

- Team determined that the test was failing good units.
- Determined failures were related to rotation speed of the cam

Effect of test rotation speed on radius rejects

Current operating speed



CONCLUSION: WITH THE CAM ROTATION SPEED OF **70000**, FALSE REJECTS CAN BE REDUCED BY A FACTOR OF **10**

Chi-Square Test

Expected counts are printed below observed counts

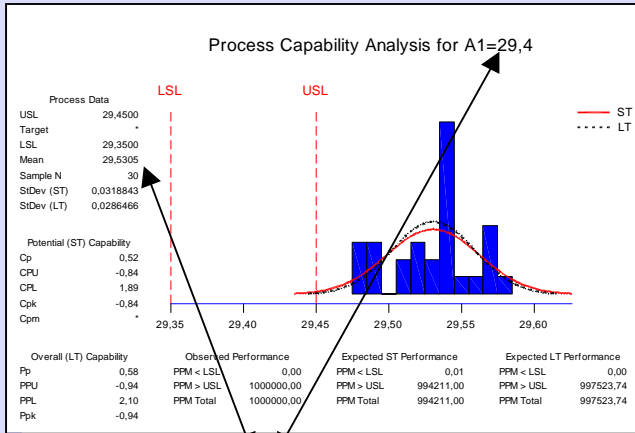
	Test1	Test2	Total
50000	96	4	100
	83.89	16.11	
70000	97	3	100
	83.89	16.11	
90000	93	7	100
	83.89	16.11	
100000	33	37	70
	58.72	11.28	
120000	75	25	100
	83.89	16.11	
150000	59	11	70
	58.72	11.28	
Total	453	87	540

$$\text{Chi-Sq} = 1.748 + 9.104 + 2.049 + 10.670 + 0.990 + 5.152 + 11.267 + 58.667 + 0.942 + 4.904 + 0.001 + 0.007 = 105.502$$

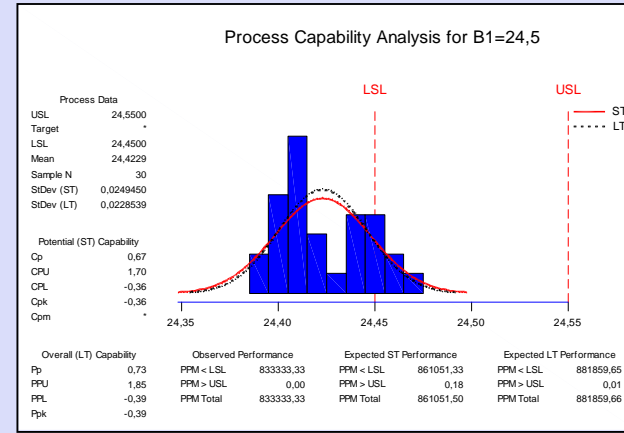
DF = 5, P-Value = 0.000

However.....

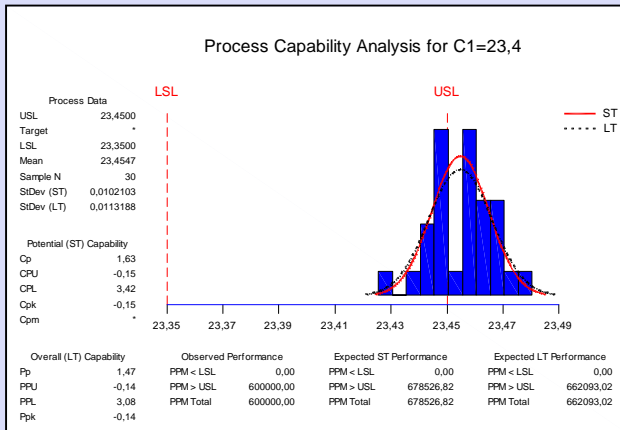
We were failing our suppliers for perceived Variation on Critical Dimensions.



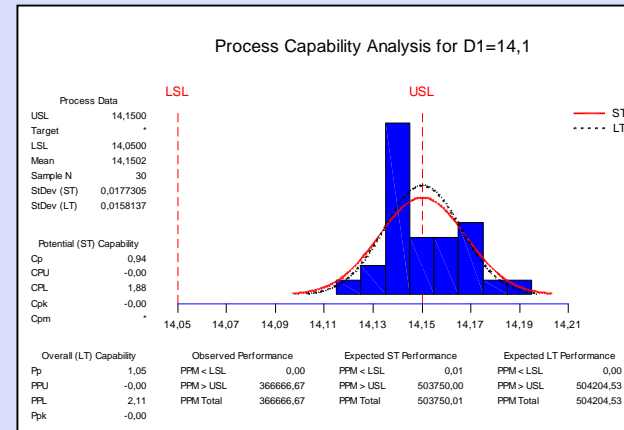
Mean = 29.53 Stdev. = 0.028368



Mean = 24.4285 Stdev. = 0.02399

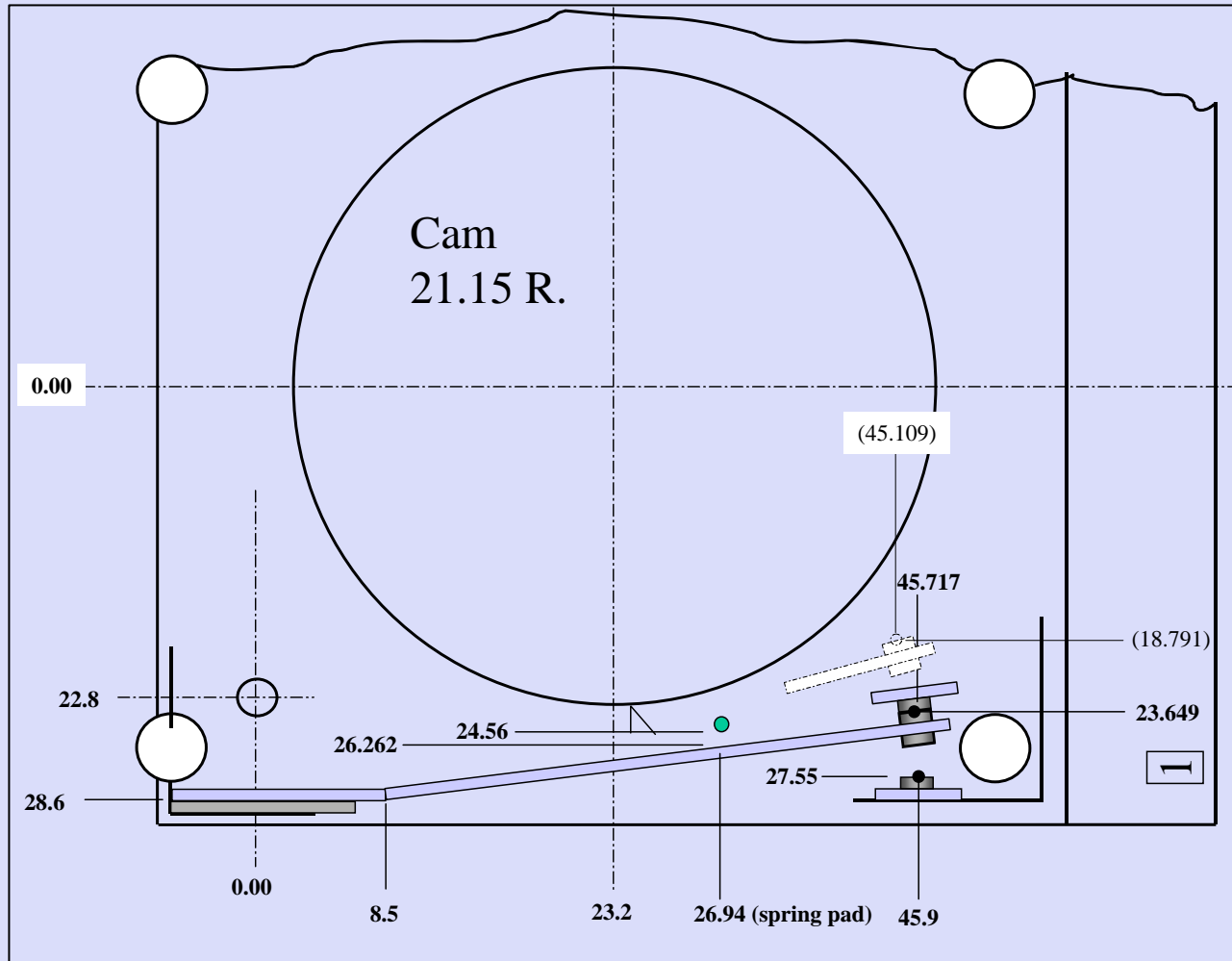


Mean = 23.4538 Stdev. = 0.0239959



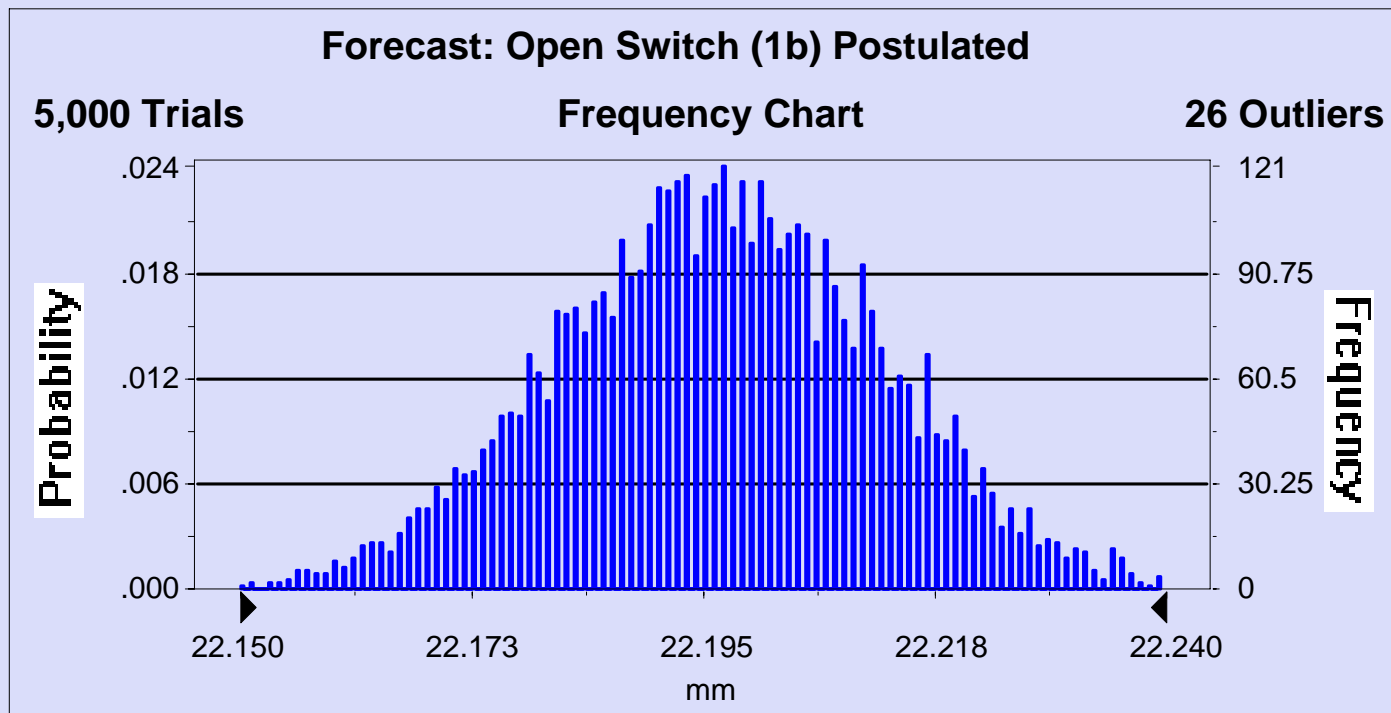
Mean = 15.15 Stdev. = 0.0161965

Tolerance Analysis Was Needed on the CAM



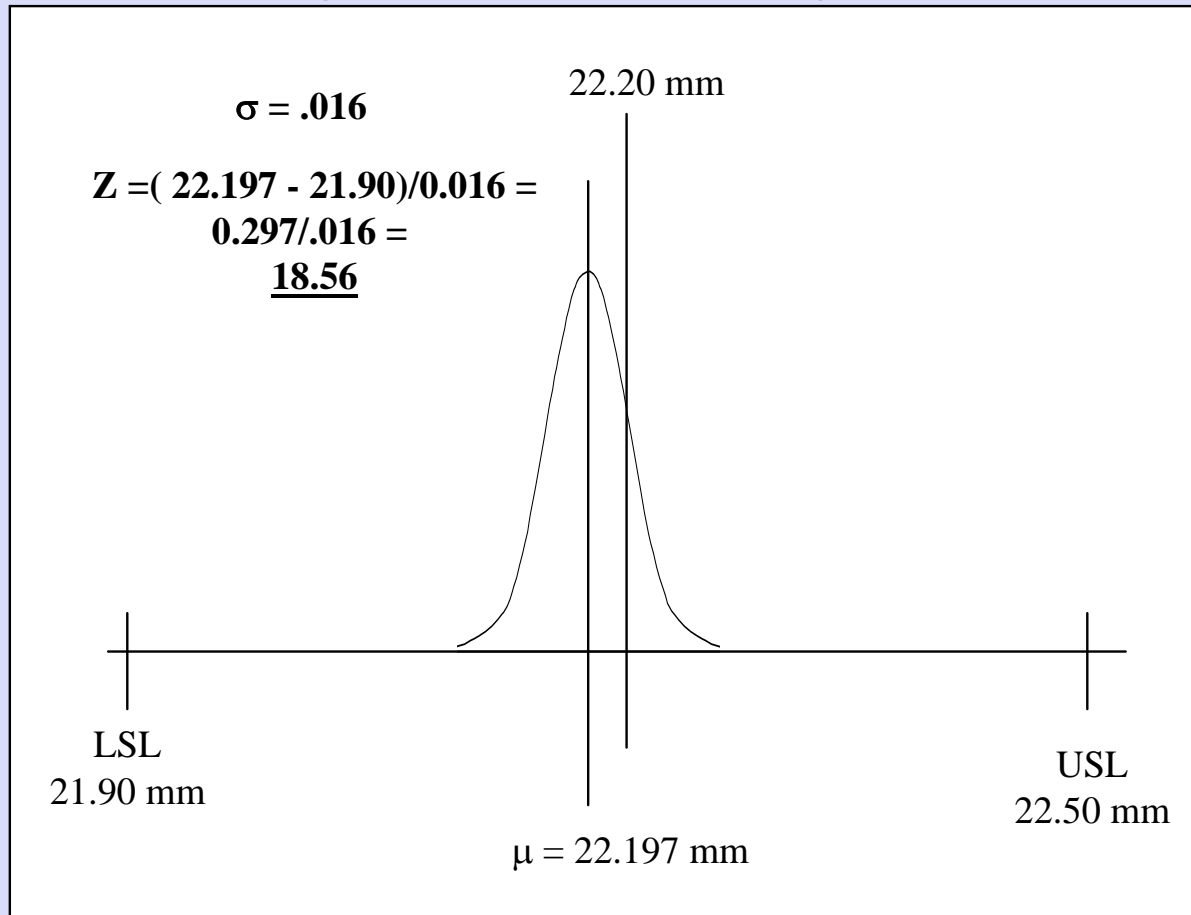
Statistical Tolerancing

- Statistical Tolerancing was performed on the switch, considering all sources of variation in the supply chain
- The following distribution was calculated



Compared to the Specification for an Open

- We were WAY inside the performance parameters required
- We were scrapping supplier material against unrealistic specs



Which allowed....

- The Company was able to qualify a new supplier for \$700k a year savings.
- The team had previously disqualified this supplier for not meeting specs.
 - Until the Six Sigma team determined that current suppliers failed to meet the same specs and actually had more variation
 - Why? Because the specs did not match customer expectations.