



## 46th Annual Fall Technical Conference

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### Use of Capability Indices to Drive Part Quality



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## Outline

### I. Orientation

- Technology
- The Seven Steps of Quality Management

### II. Examples of how capability indices are used

- Wiper Blade : Qualification steps & Quality Plan
- Reclaim Assembly : Supplier selection
- Pivot Arm : Corrective actions
- Foam Roller : Qualification & trend charting

### III. Conclusion



## Xerox Office Printing Business Wilsonville OR

**Phaser 8200** introduced Spring 2002  
Office Network Printer, Tektronix by Xerox  
16 ppm Full Color, 1200 dpi Photo Mode

### Motivation :

Large percentage of purchased parts

Supply chain management

- managing part quality
- meet design intent & specifications





## The Seven Steps of Quality Management

**Step 1 : Supplier Selection.** Identify, evaluate and select suppliers that meet Xerox OPB's technology, quality, service and total cost objectives.

**Step 2 : Manufacturing Process Development.**

**Step 3 : Tooling Manufacturing.** Develop tooling and fixtures for custom designed parts and modules.

**Step 4 : Process Qualification & Control.**

**Step 5 : Quality Plan.**

**Step 6 : Release to Production.** Ensure that all quality management requirements have been satisfied prior to production.

**Step 7 : Continuous Improvement.** Improve quality and lower cost over product life.



## Step 2 : Manufacturing Process Development

Development of capable processes (*force visibility of process capability mismatches with design requirements*); occurs concurrent with design development

### *Key elements :*

Communication of design requirements in the form of Critical To Function (CTF) features

Identification of critical manufacturing processes and estimates of their capability

Flow charts of proposed manufacturing processes

Process characterization and process based cost modeling



## **Step 4 : Process Qualification & Control**

**Establish manufacturing process & tooling capability prior to release for production**

***Key elements :***

**Capability studies on all CTF/CTP part dimensions & features**

**First article inspection**

**Selection of CTF/CTP dimensions for ongoing SPC and VOE**

**Set sampling methodology and control limits for SPC**



## Step 5 : Quality Plan

Develop Quality Plan with supplier to ensure design requirements are met throughout product life

### *Key elements :*

Quality goals (Cp, Cpk, ppm)

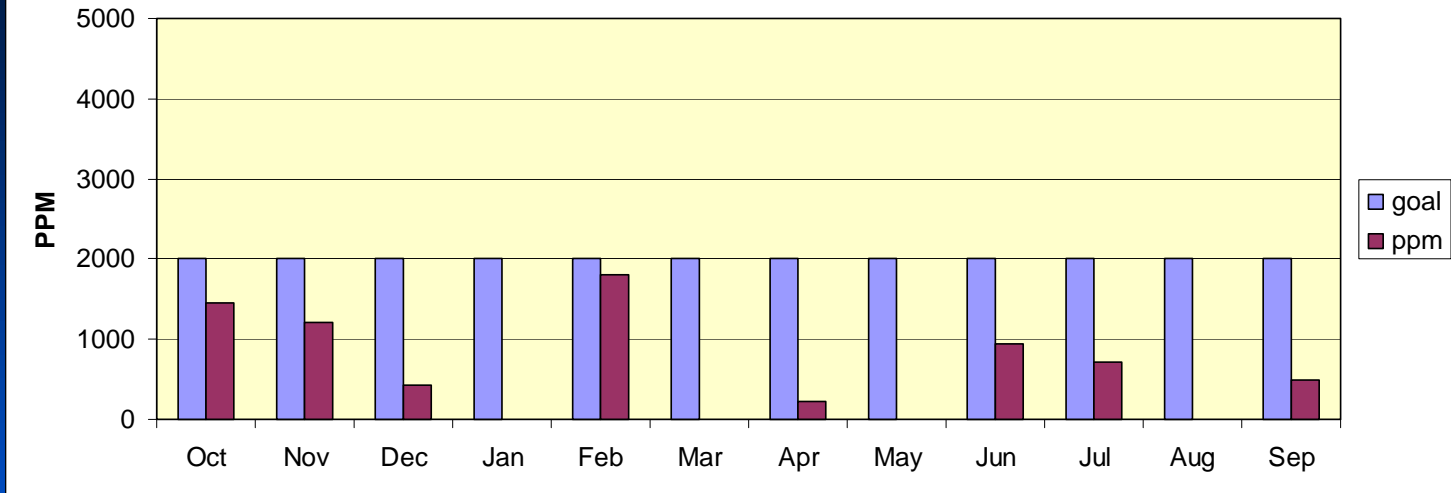
CTF/CTP dimensions and features to be reported

Measurement and inspection methods

Reporting requirements for SPC and VOE



Sample PPM Chart



12 Month Rolling

Data	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Total Qty Received	66,344	27,210	64,639	30,654	49,727	29,527	55,868	101,126	44,954	30,520	21,468	80,978
Total Qty Rejected	96	33	28	0	90	0	13	0	42	22	0	40
Supplier PPM	1,447	1,213	433	0	1,810	0	233	0	934	721	0	494
On-Time Performance	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	98%	100%
<b>Part #'s Rejected</b>												
000-0000-00	6		8									16
000-0000-00	14								15			
000-0000-00		23			40					22		
000-0000-00	42	10	13		15							20
000-0000-00	21				16							
000-0000-00							13					
000-0000-00												4
000-0000-00			7		19							
000-0000-00	13											
000-0000-00									27			





**Introduction**

Welcome to the main office training module supplied with industry systems. Choose from any of the following options:

- TRAINING INTRODUCTION**  
If you're new to using the service desktop, or are having trouble.
- TRAINING COURSE**  
Access all training courses, designed to educate staff on product safety, our processes and our company's core values.
- NEW USER**  
How to get your products implemented for sales calls.
- CONTACT US**  
Have a question for your CRM Support Quality Program?

**News and Announcements**

- CRITICAL UPDATE**  
The new version is coming, you will receive some changes.
- NEW USER TRAINING**  
Go to our new paragraphs, review and practice information.
- TRAINING COURSE: PRODUCT SAFETY**  
Color training & sample network. Quarterly releases. The "SAFE, ASBEST" HEALTH!

**Announcements**

Important added questions, comments to help most frequently asked questions.

Dear Member for Customer Services - comments for feedback, please!

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Enter your user and password in the following fields, and click continue to proceed. If you do not have a password, please contact the administrator.

user:

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**USMT (USMT)**

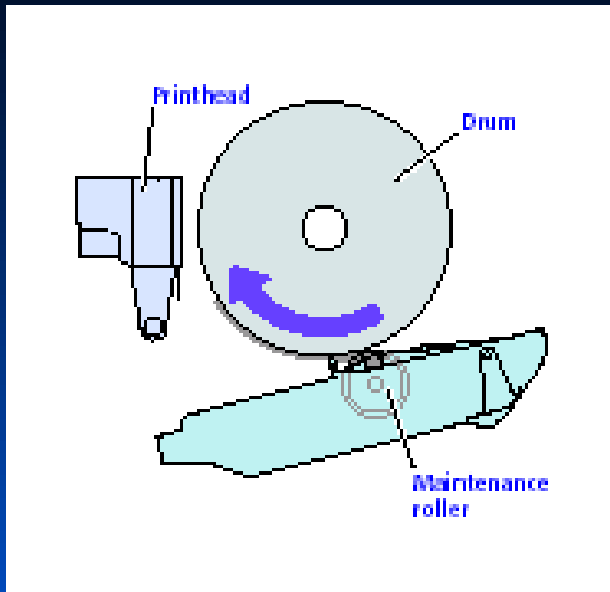
- USMT**
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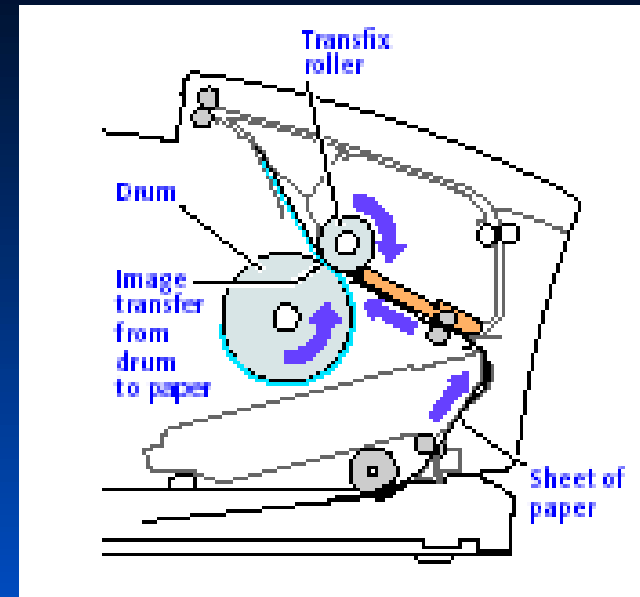
**USMT (USMT)**

- USMT**
- USMT**
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- USMT**

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## Solid Ink Printing Process



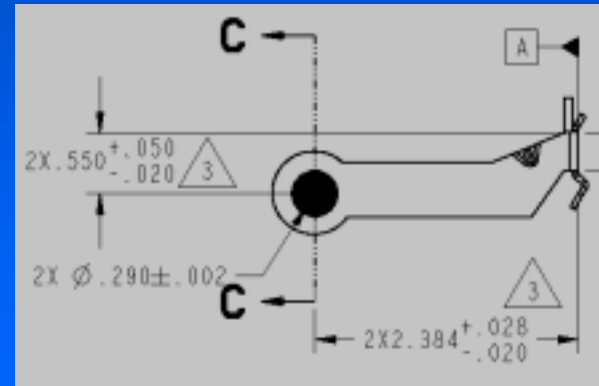
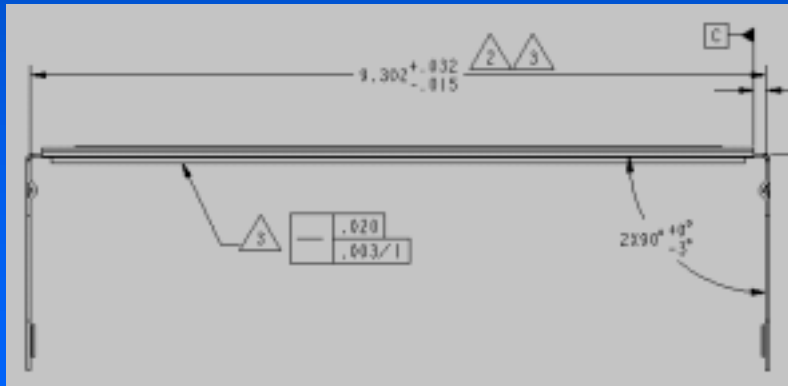
## Drum Maintenance Parts





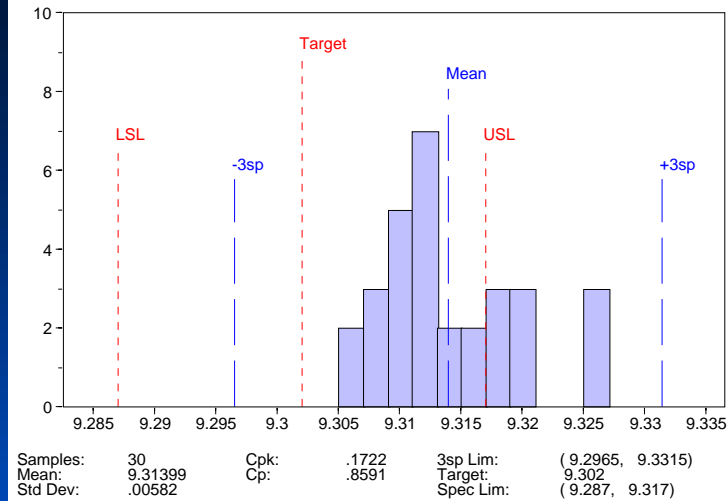
## Drum Maintenance Wiper Blade

### Qualification Steps & Quality Plan



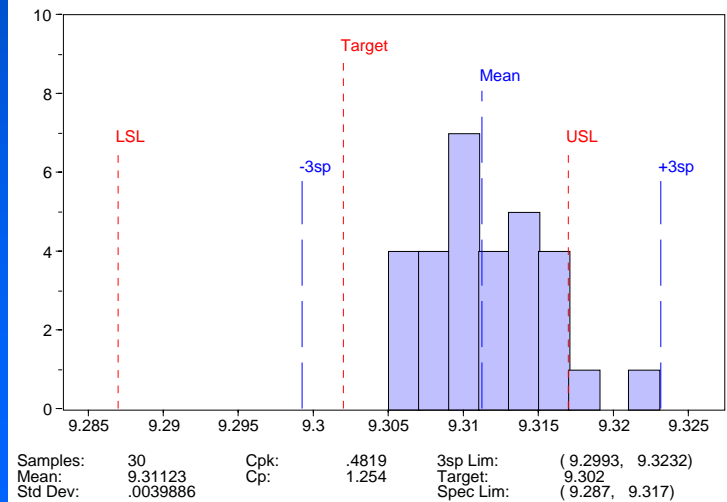


Capability Studies for Wiper Blade Length, trial 1

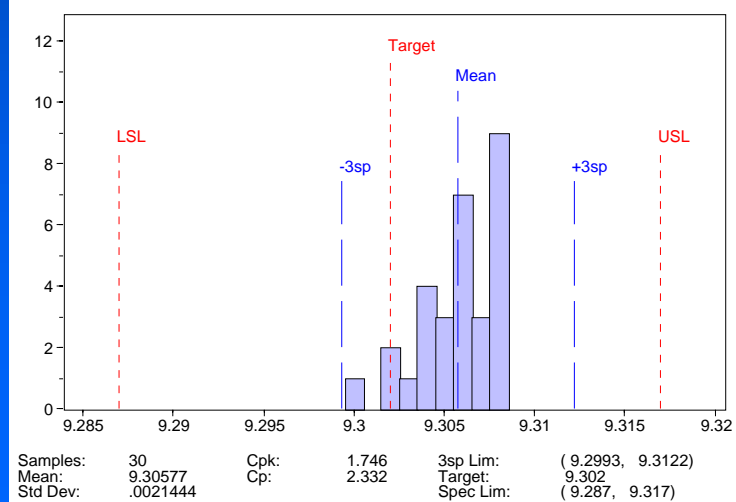


- 3 Manufacturing Trials
- At least 1 month apart
- #1 & #2 disappointing
- #3 passes the indices criteria ... but there's a problem!

Capability Studies for Wiper Blade Length, trial 2

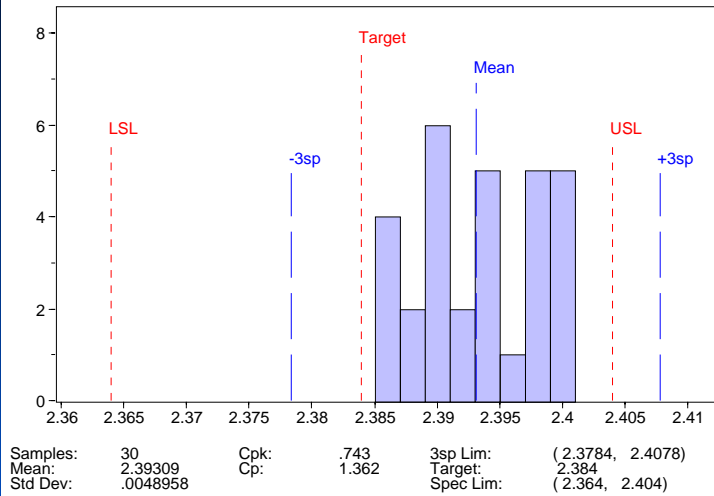


Capability Studies for Wiper Blade Length, trial 3



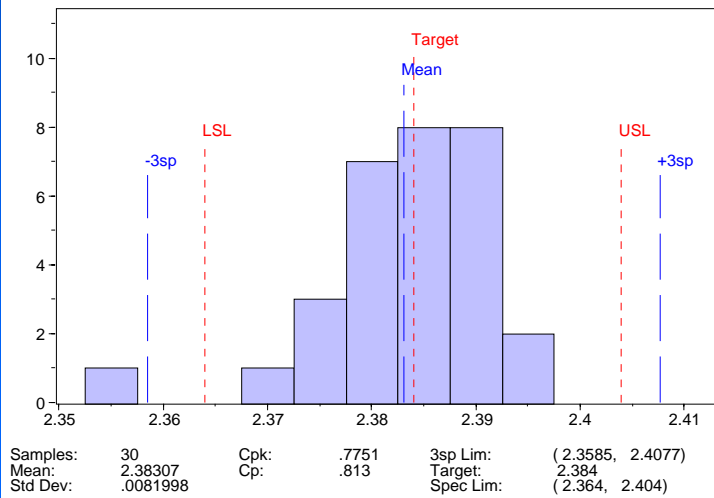


Capability Studies for Wiper Blade  
Leg Height, left, 1st trial

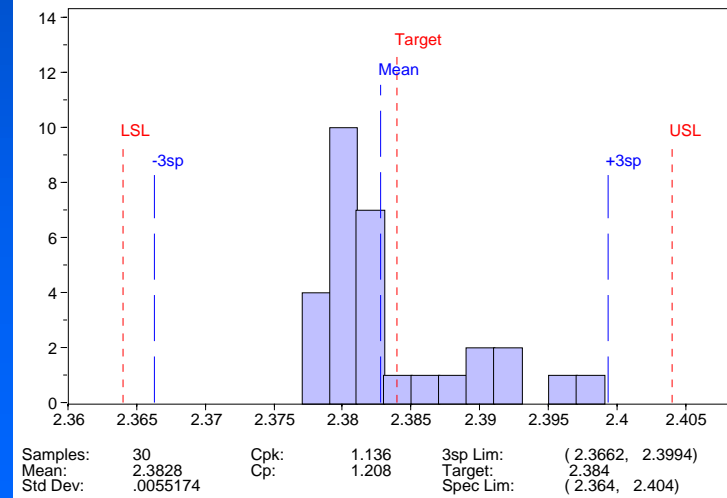


- #2 : is this an outlier or measurement problem?
- #3 : same evidence of sort

Capability Studies for Wiper Blade  
Leg Height, left, 2nd trial

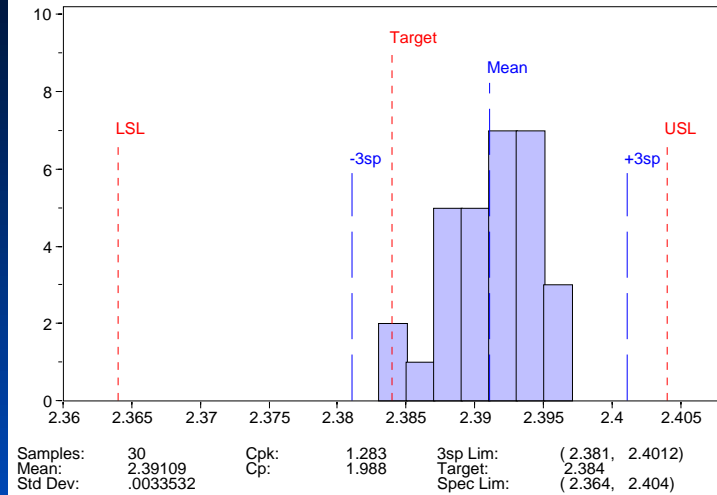


Capability Studies for Wiper Blade  
Leg Height, left, 3rd trial



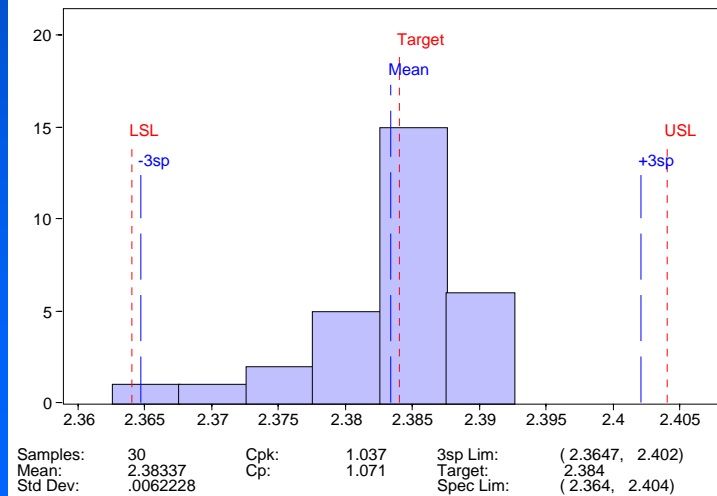


Capability Studies for Wiper Blade  
Leg Height, right, 1st trial

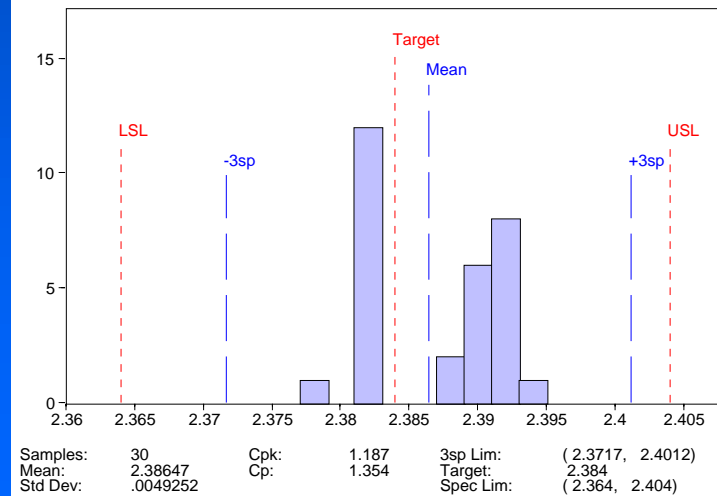


- sometimes it gets worse before it gets better due to process adjustments on other dimensions
- and sometimes sorting “fixes” one thing and messes up another

Capability Studies for Wiper Blade  
Leg Height, right, 2nd trial

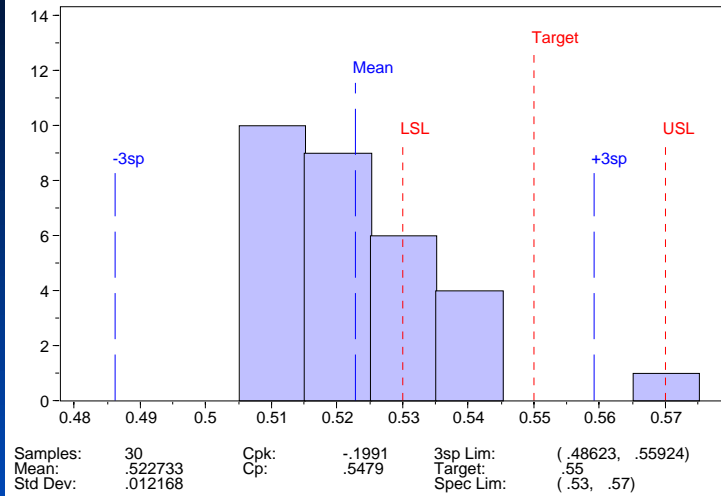


Capability Studies for Wiper Blade  
Leg Height, right, 3rd trial



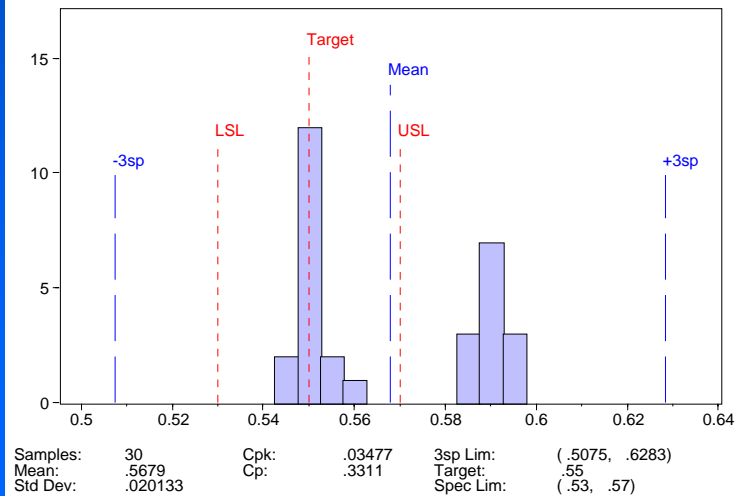


Capability Studies for Wiper Blade  
Leg Alignment, left, 1st trial

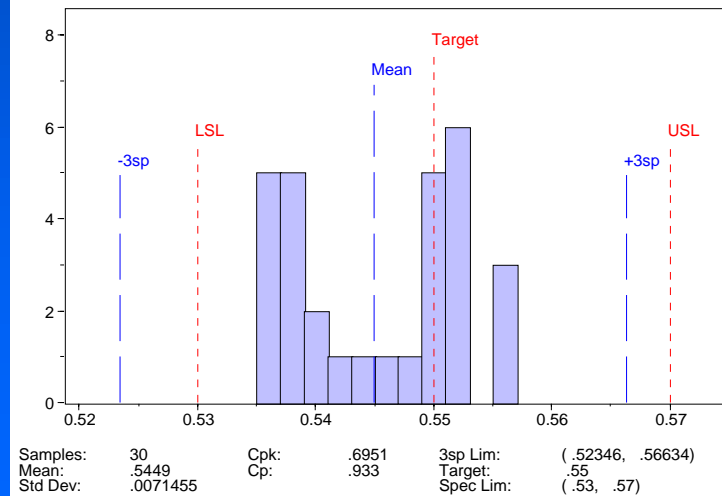


Previous graphs showed out lyers and worsening capabilities on trial #2. The supplier adjusted the process in the middle of the run for this dimension & affected the others.

Capability Studies for Wiper Blade  
Leg Alignment, left, 2nd trial

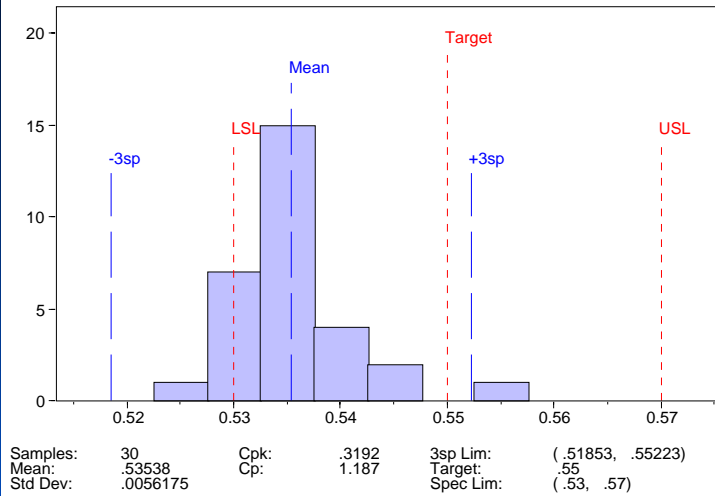


Capability Studies for Wiper Blade  
Leg Alignment, left, 3rd trial



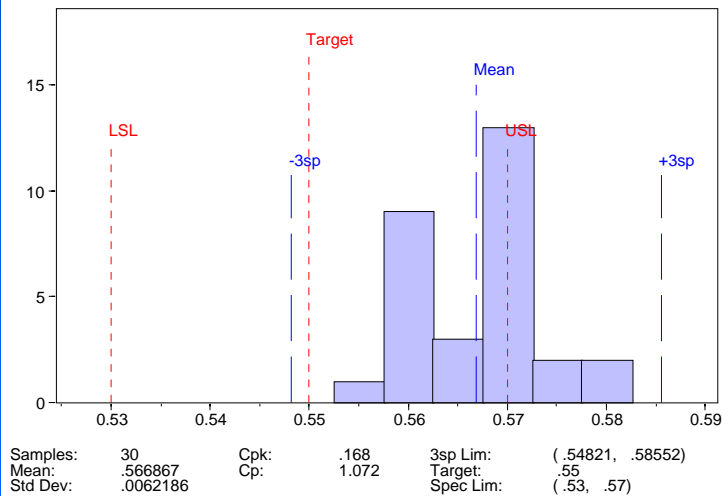


Capability Studies for Wiper Blade  
Leg Alignment, right, 1st trial

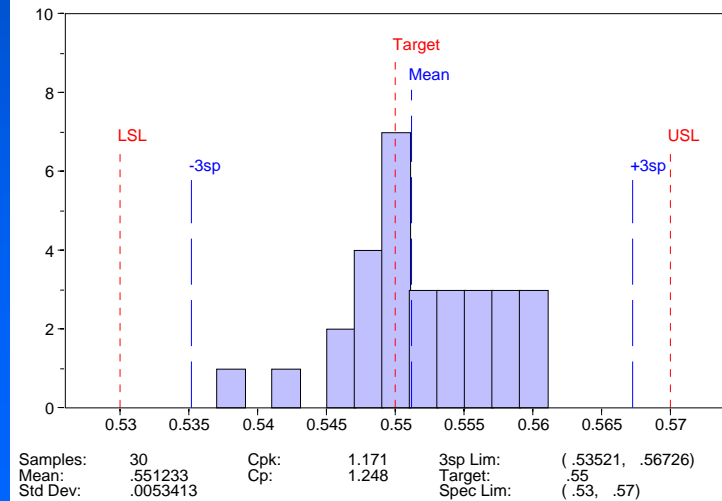


Each trial presents the supplier with an opportunity to better understand his process and Xerox requirements

Capability Studies for Wiper Blade  
Leg Alignment, right, 2nd trial



Capability Studies for Wiper Blade  
Leg Alignment, right, 3rd trial







# Quality Plan

- Part of the drawing
- Process qualification called out
- Ongoing requirements

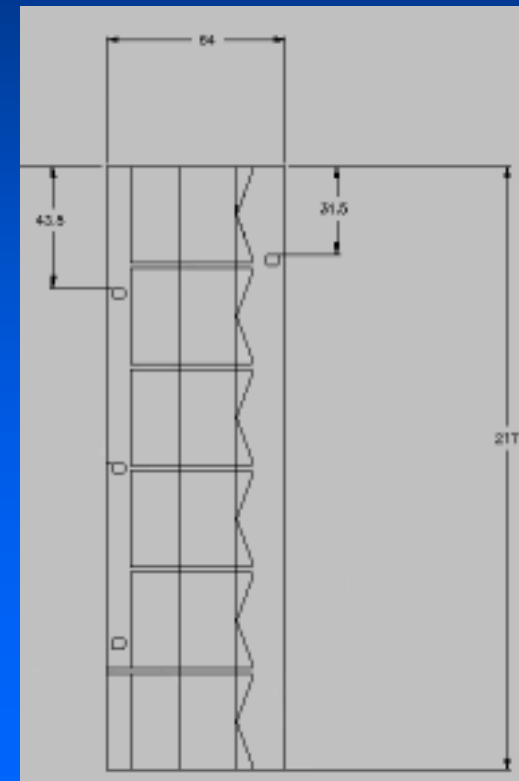
4		3		2		1		
<b>QUALITY PLAN</b> CRITICAL IDENTIFICATION BELOW ARE CRITICAL TO FUNCTION (CIT) OR QUALITY (CQ) FUNCTIONS TO BE QUALIFIED. QUALITY PLAN IS A PART OF THE DRAWING AND SHALL BE MAINTAINED AS SUCH.				THIS DRAWING AND IDENTIFICATION ARE TO BE MAINTAINED THROUGHOUT THE LIFE OF THE PRODUCT TO WHICH THIS QUALITY PLAN APPLIES. THE QUALITY PLAN IS PART OF THE DRAWING AND SHALL BE MAINTAINED AS SUCH. THE QUALITY PLAN IS A PART OF THE DRAWING AND SHALL BE MAINTAINED AS SUCH. THE QUALITY PLAN IS A PART OF THE DRAWING AND SHALL BE MAINTAINED AS SUCH.				
QTY	REV	DATE	DESCRIPTION	BY	CHKD	DESCRIPTION OF CHANGE	ON DT	BY
1	001	100	INITIAL QUALITY PLAN			SEE SHEET 1	--	--
2	001	100	PROCESSING METHOD					
3	001	100	PROCESSING METHOD					
4	001	100	PROCESSING METHOD					
5	001	100	PROCESSING METHOD					
6	001	100	PROCESSING METHOD					
7	001	100	PROCESSING METHOD					
8	001	100	PROCESSING METHOD					
9	001	100	PROCESSING METHOD					
10	001	100	PROCESSING METHOD					
11	001	100	PROCESSING METHOD					
APPROVAL SIGNATURES: APPROVE QUALITY PLAN FOLLOWS [ ] PART QUALITY PLAN AND PROCESS CONTROL PLAN.				XEROX <sup>®</sup> The Document Company RELEASE FOR SERVICE TO: [ ] REV: [ ] DATE: [ ] BY: [ ] CHKD: [ ] SEE MATERIALS LIST N/A TITLE: BLADE ASSY. WIPER REV: 0 DATE: 307-0498-01 PAGE 1 OF 1				

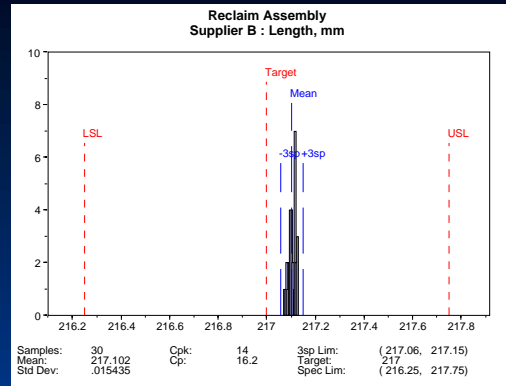
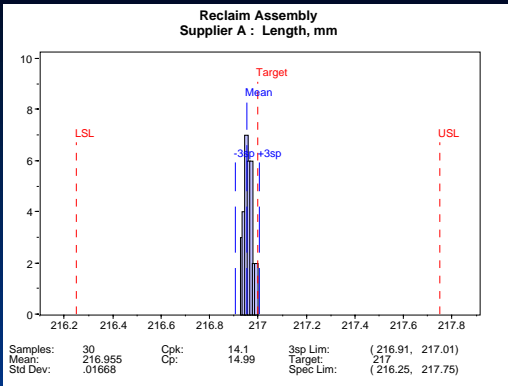


## Reclaim Assembly

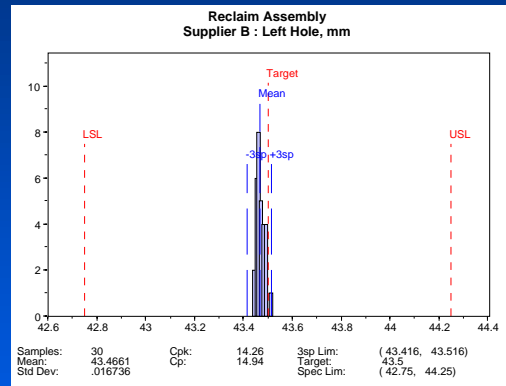
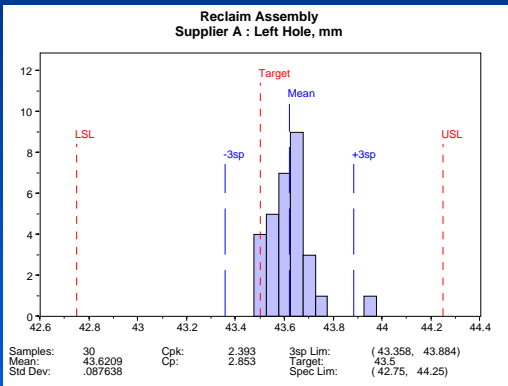
### Supplier Selection

*Dimensions are in mm*



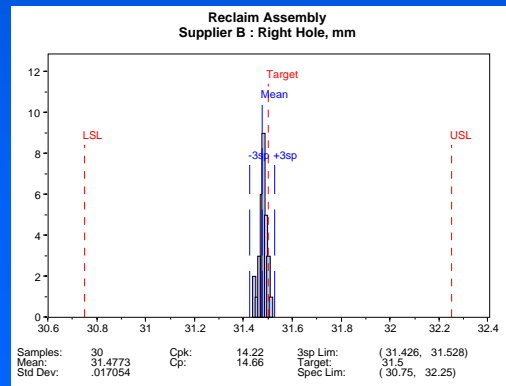
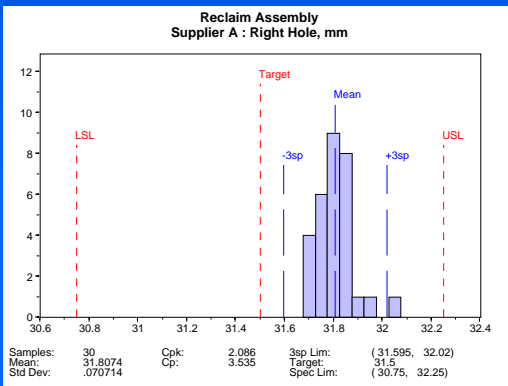


Which supplier is better ?



Consider

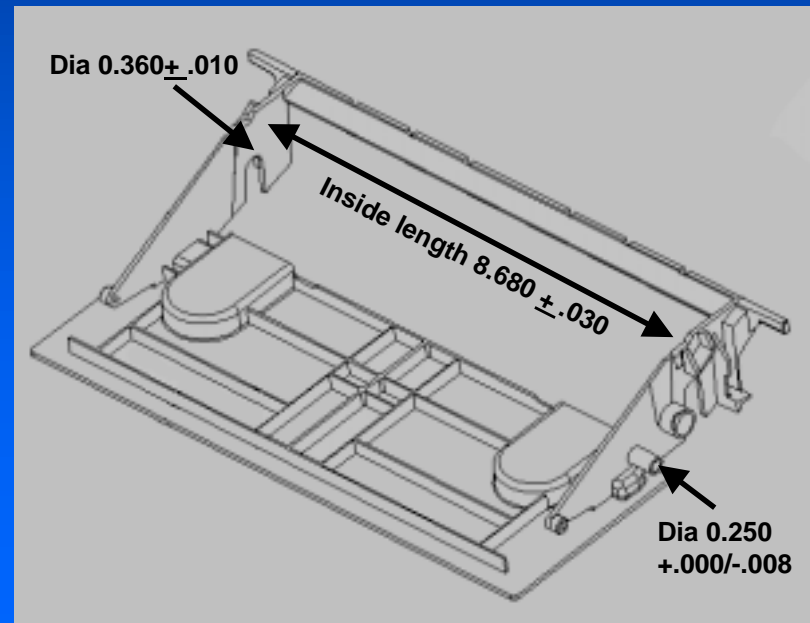
- part performance
- capability
- history
- total cost

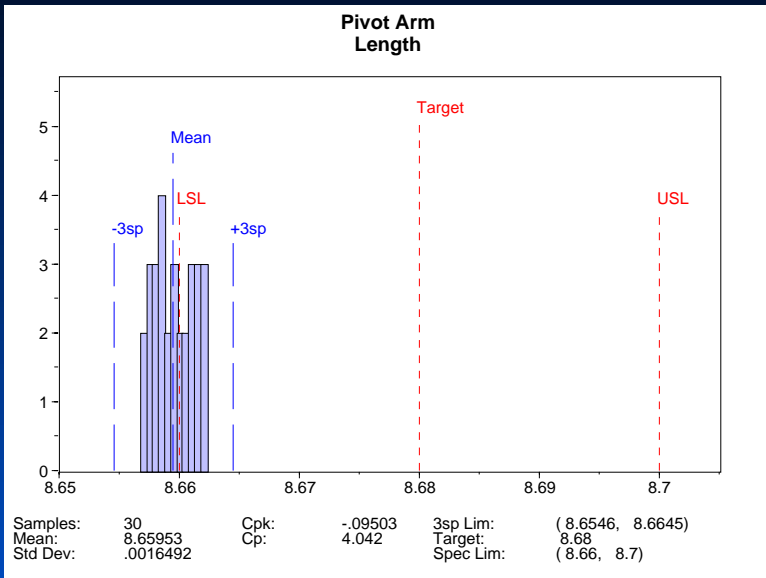




## Pivot Arm

### Corrective Actions



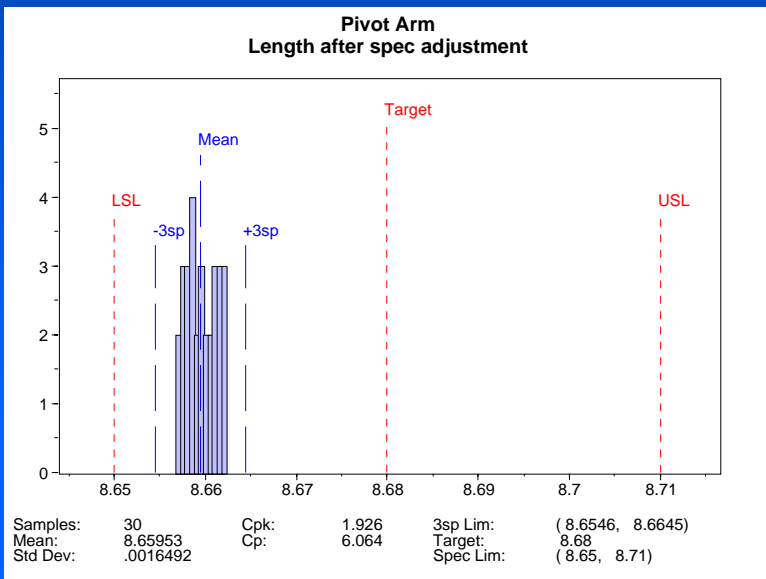


**What happens when the tool isn't capable?**

**Does system testing validate the tolerance?**

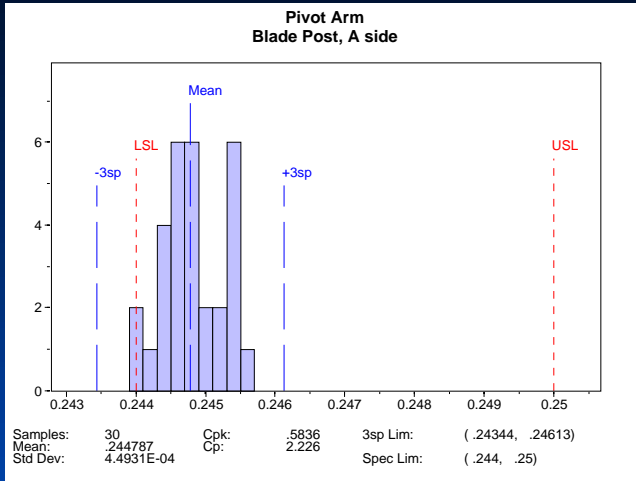
**Yes : Modify tool**

**No : Change the tolerance**

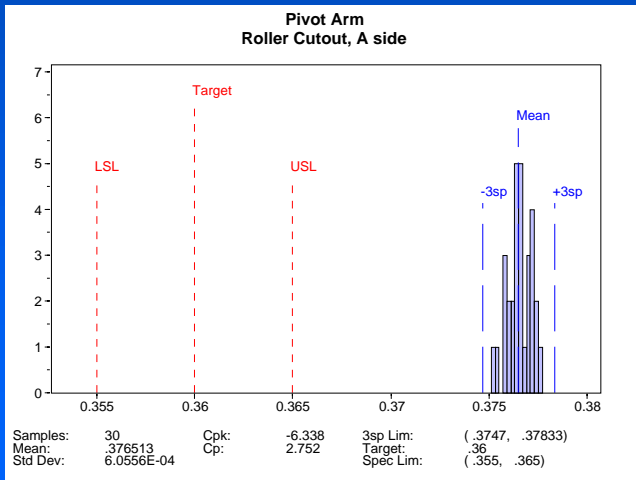
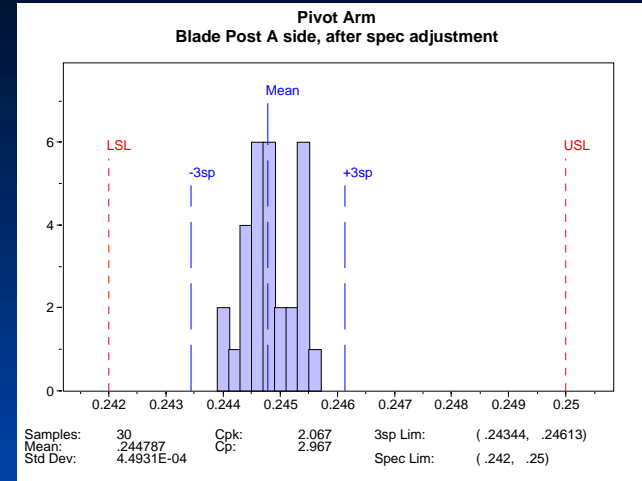


**Length tolerance was +/- .020 with Cp 4.04, Cpk -.095**

**Opened to +/- .030 with Cp 1.93, Cpk 6.06**

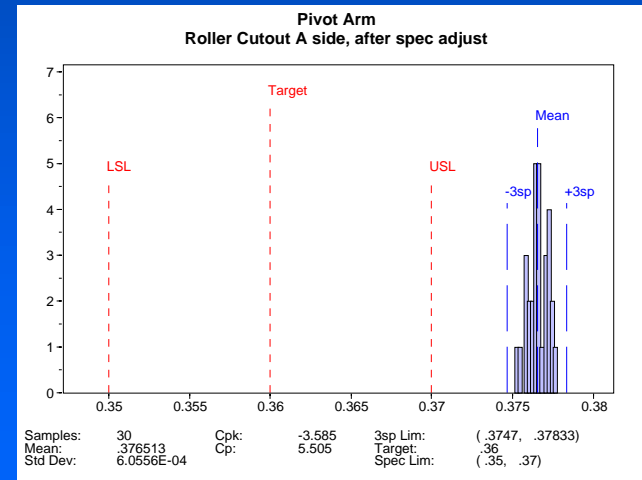


Testing supported  
tolerance change  
from  $+0.000/-0.006$  to  
 $+0.000/-0.008$



Testing supported  
tolerance change  
from  $+/-0.005$  to  
 $+/-0.010$

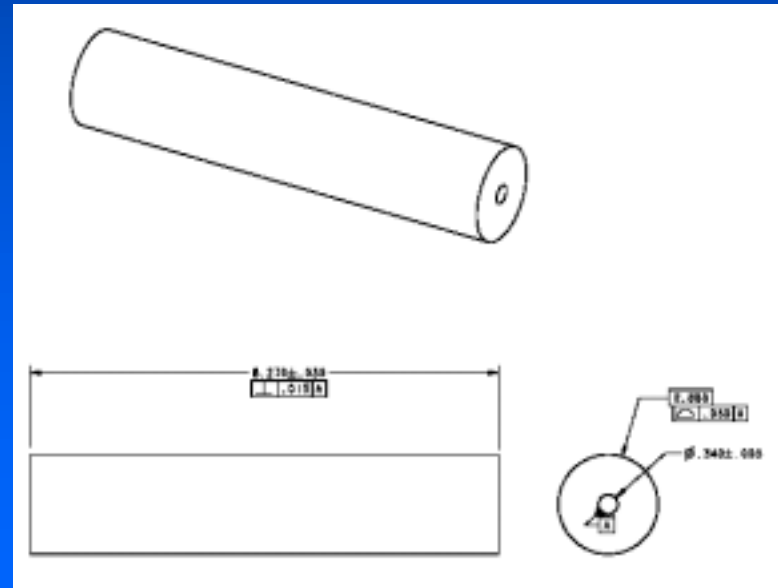
Still not capable  
Tool Modification  
required





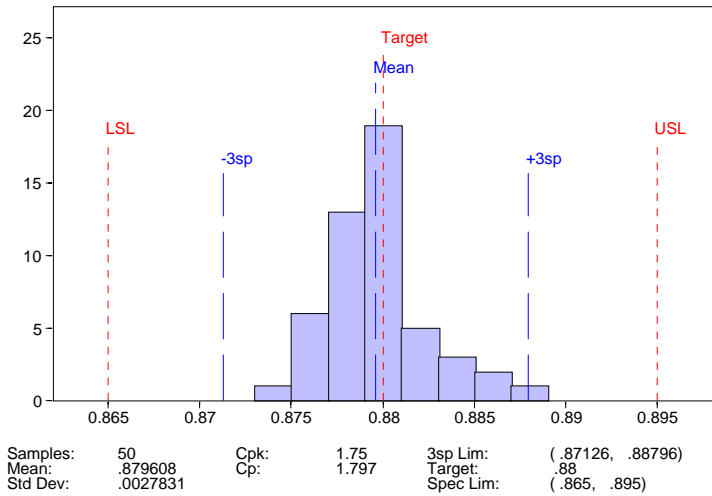
## Foam Roller

### Qualification & Trend Charting



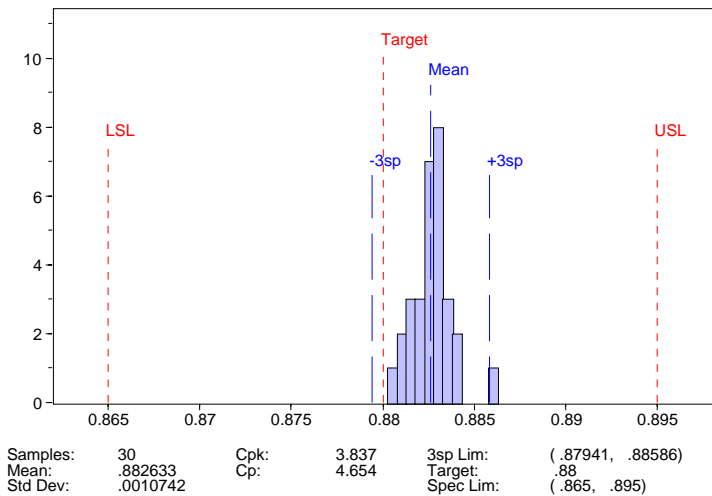


Foam Roller 1st Qual Run, Supplier B  
Radius

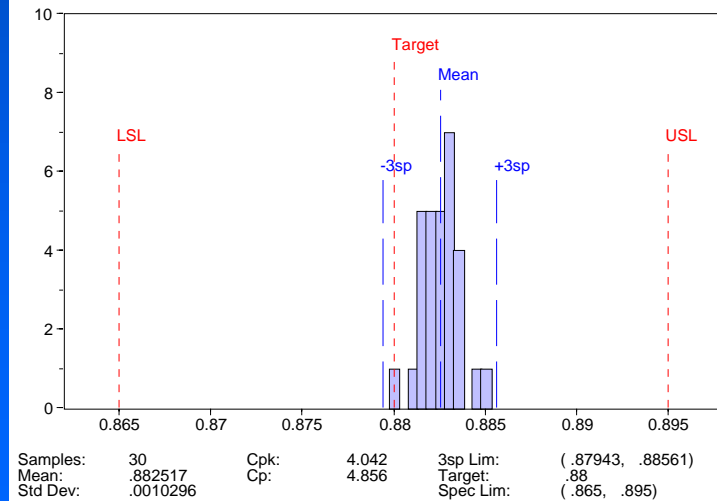


All three are acceptable qualification runs !

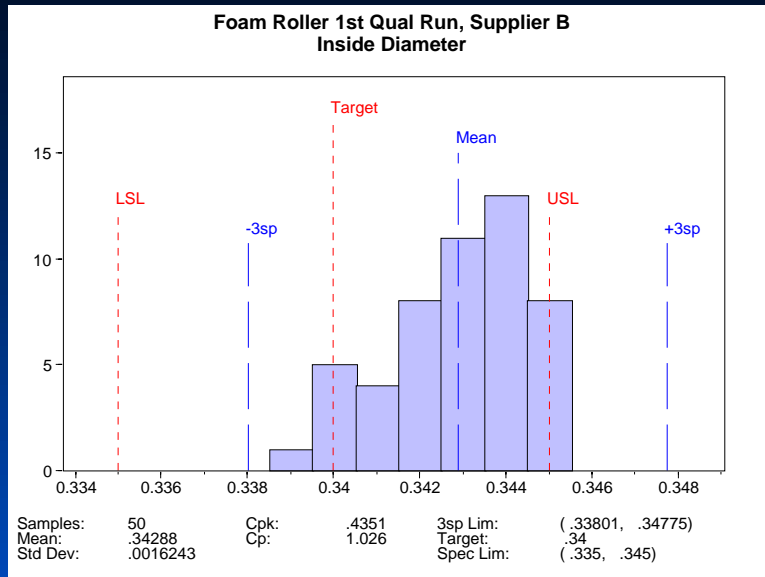
Foam Roller 2nd Qual Run, Supplier B  
Radius



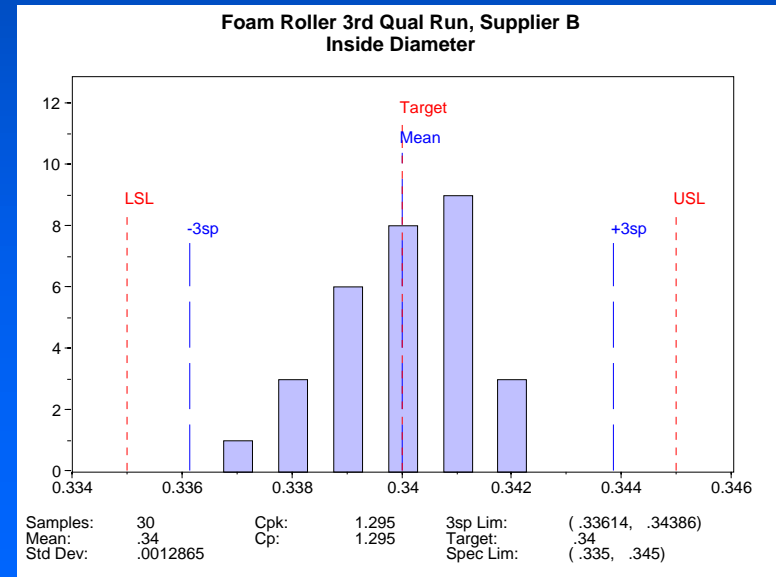
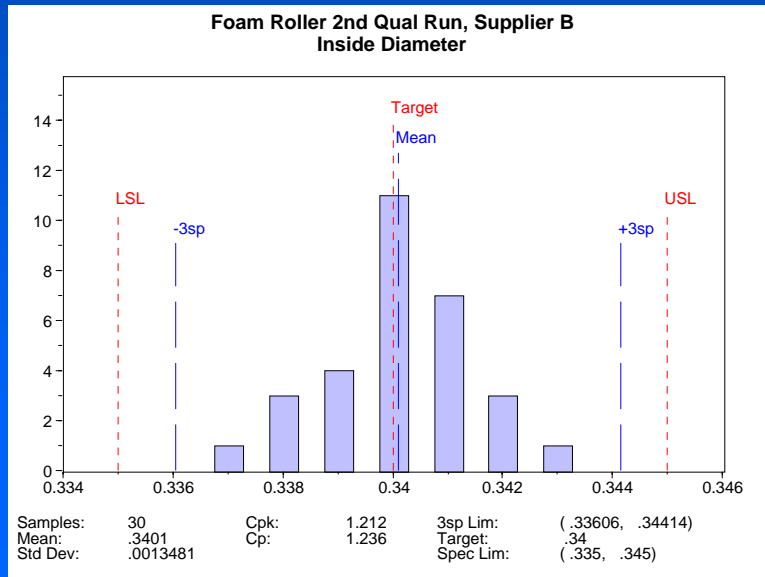
Foam Roller 3rd Qual Run, Supplier B  
Radius

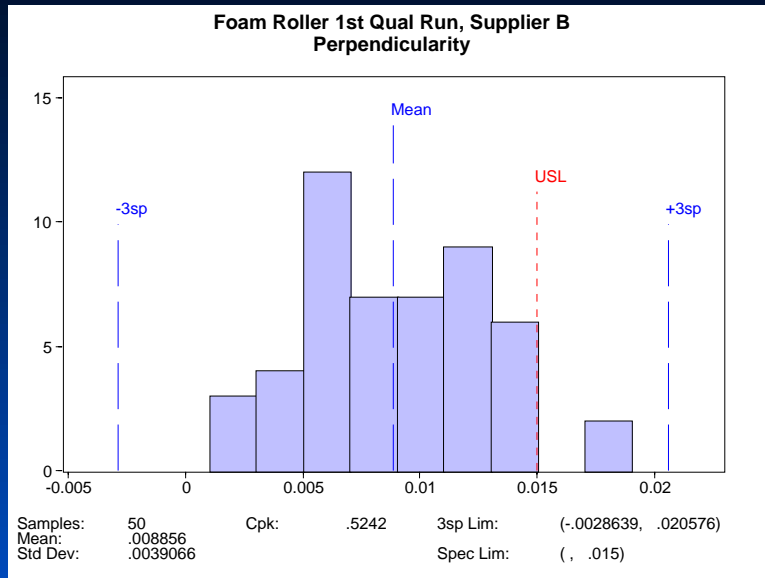




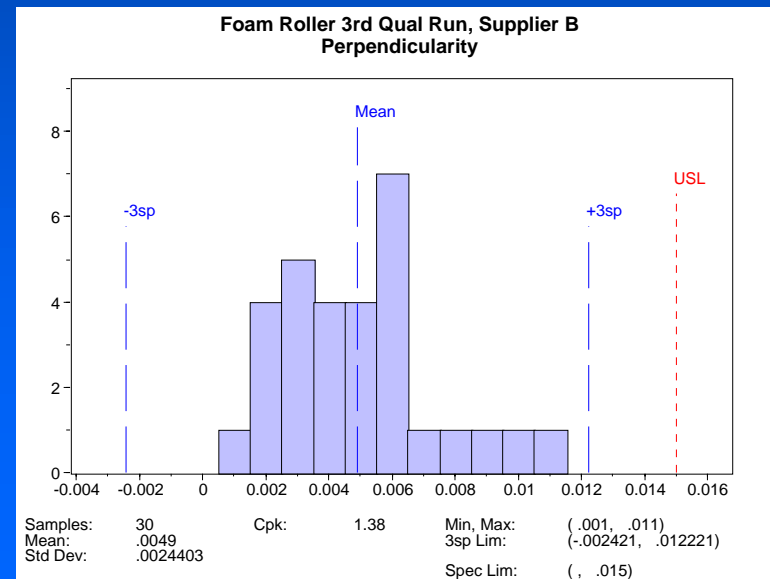
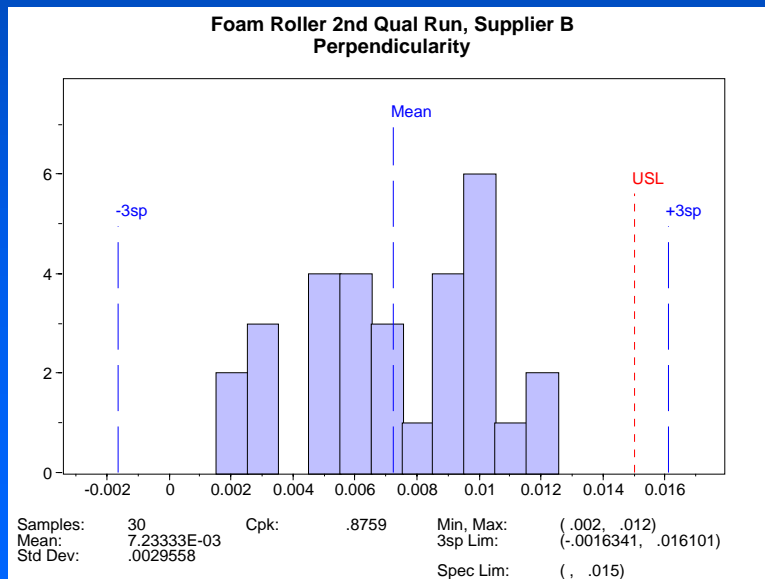


Inside diameter is close ...  
But needs improvement



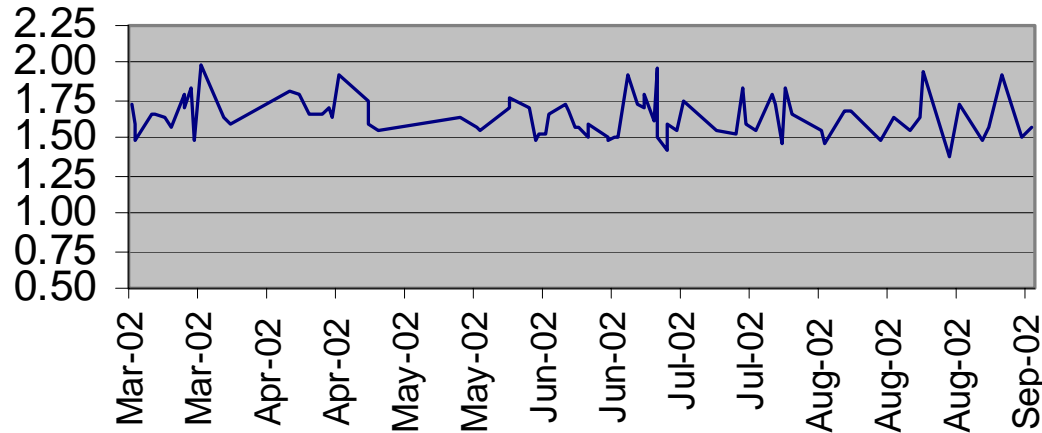


Steady improvement



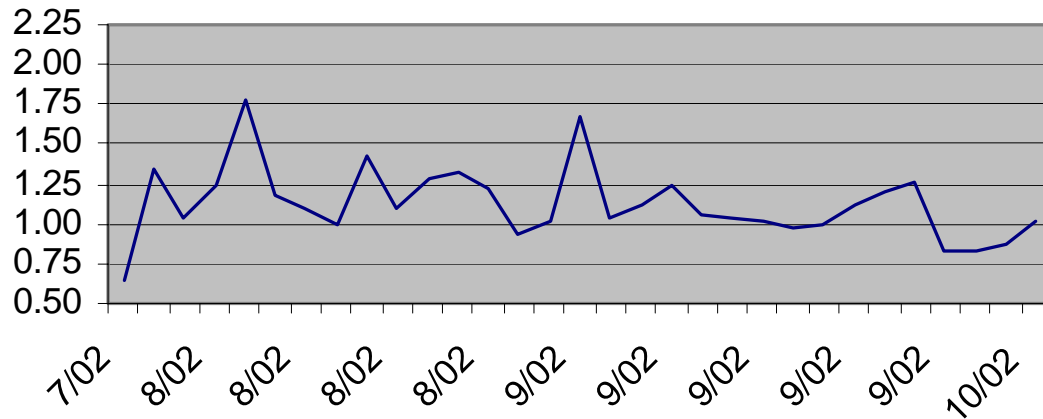


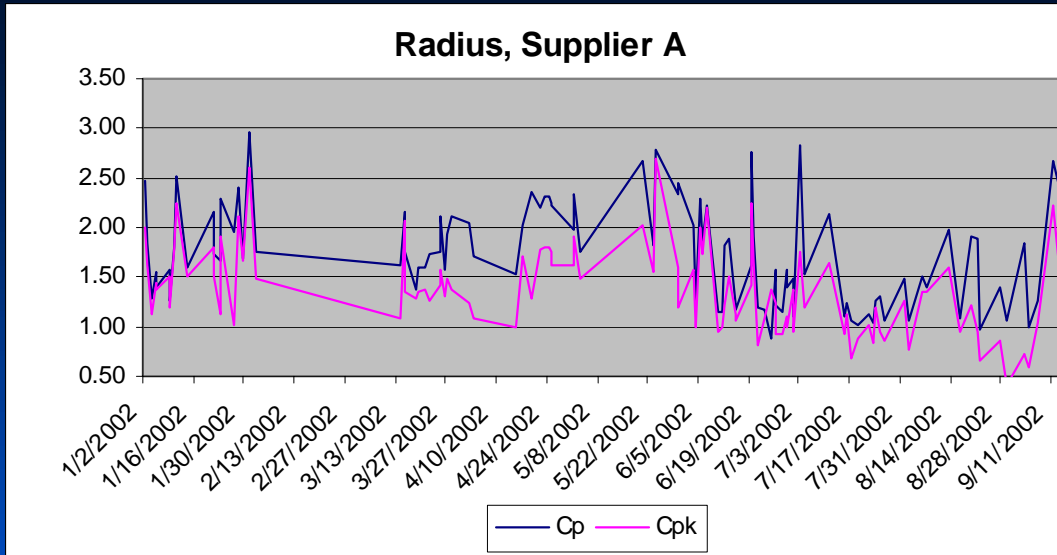
### Perpendicularity Cpu, Supplier A



**How do the capability indices trend over time?**

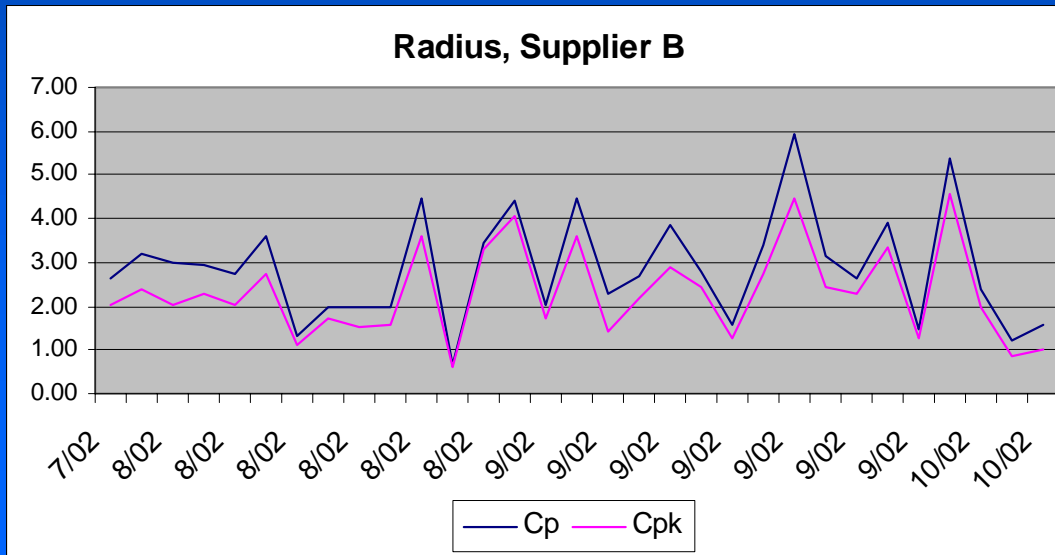
### Perpendicularity Cpu, Supplier B





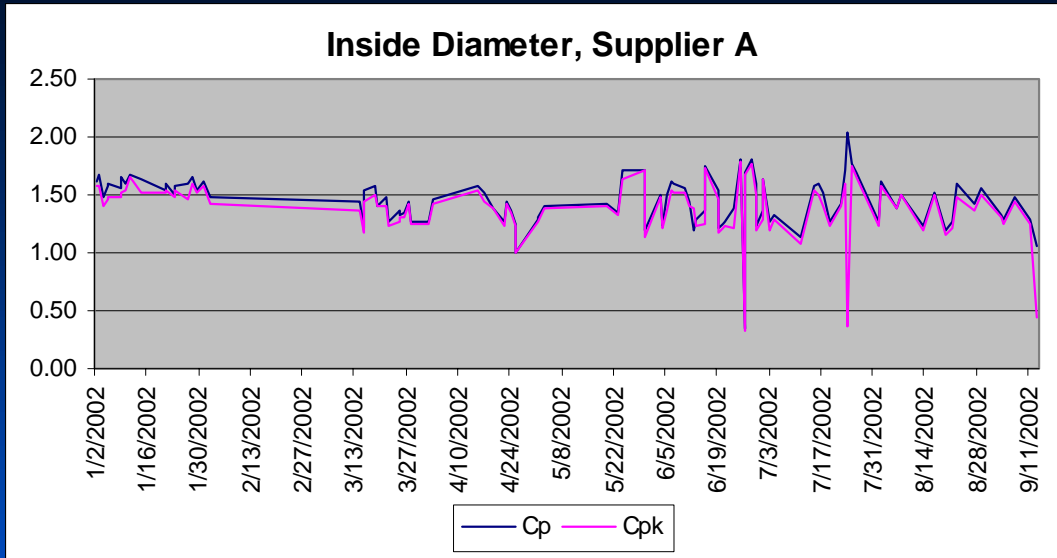
*Don't let the different scales throw you!*

**Cp & Cpk track fairly well**

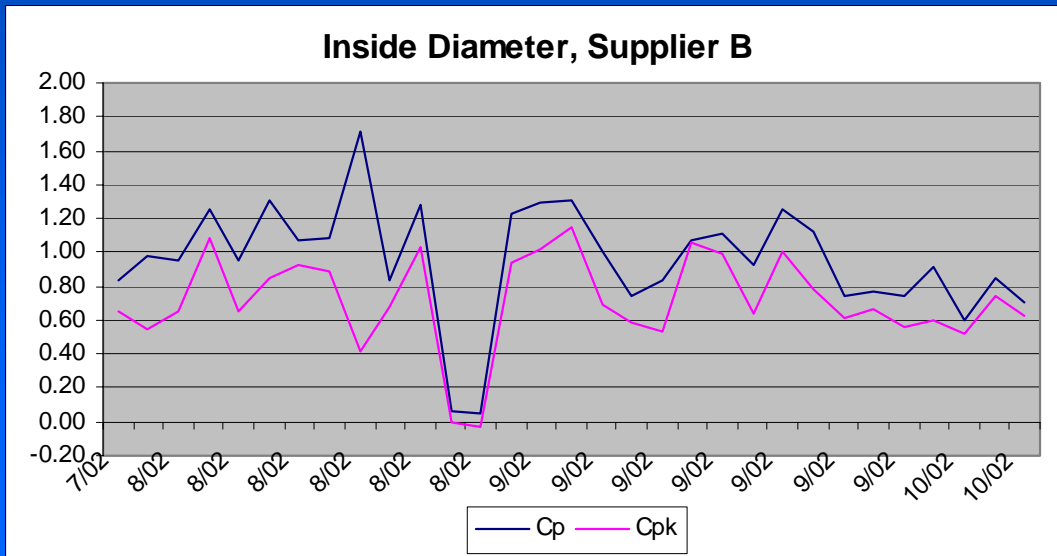


**Compare Supplier A and Supplier B for**

- overall capability
- excursions



Trend charts can put things into perspective and convince a supplier of the need to stabilize a process





## In Summary

### *What's working :*

- capability indices have proven to be an effective vehicle for communicating part quality within a run and run-to-run
- the basis for making a decision is clearly understood by all parties
- as a result of the above two, suppliers are clear about what needs improvement

### *What can be better :*

- sampling plans
- supplier ownership of capability indices