



SMG SPC 301

Greetings from ECD–U!

The session will begin at the scheduled time.

As a courtesy to others on the session **PLEASE be sure:**

- 1. Your audio is connected via phone or VoIP before the scheduled class time,**
- 2. Your phone is on MUTE during the session.
Please do NOT put your phone on HOLD**

If you would like to ask a question, please use the “chat” feature on your Go-To-Meeting dialog

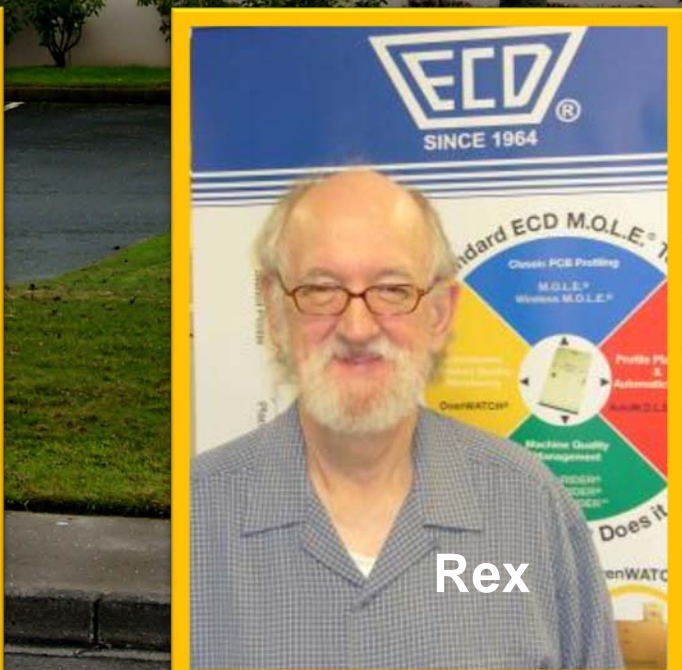
***This session may be recorded for training or distribution**



Mark



Paul

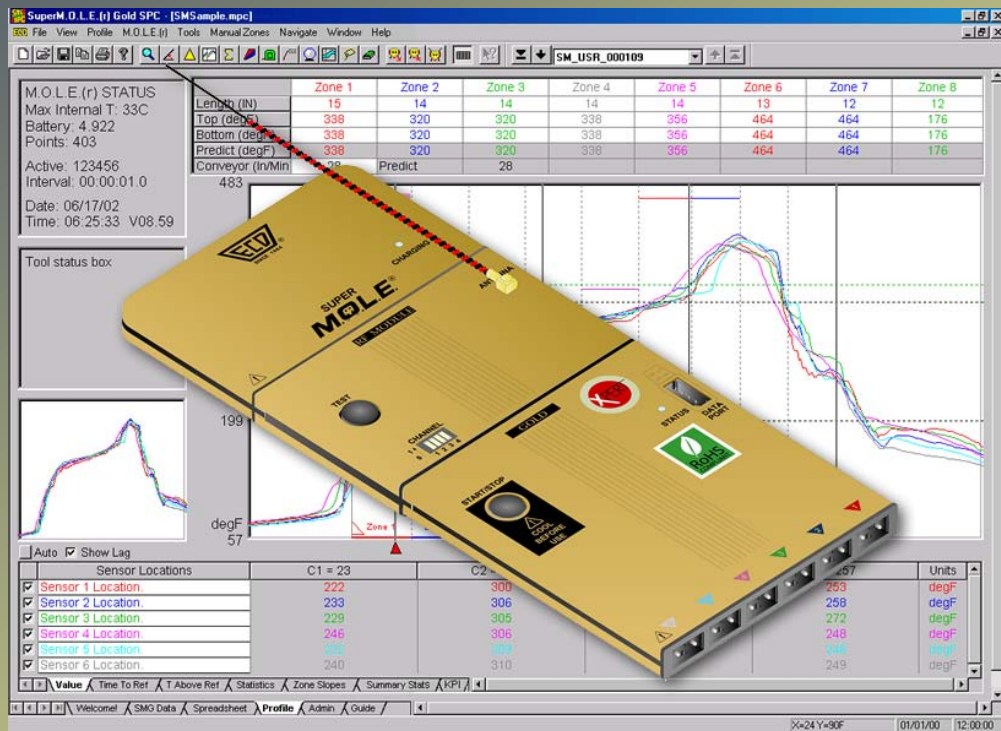


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Home of the M.O.L.E.® Profiler

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Current version
SMG 5.22f
www.ECD.com

Where ECD - University

**Product Design
& Development**

**New Product
Introduction**

Production

**Machine
Maintenance**

Requirements

Characterization

Verification



**Profile
Specification**

**Recipe
Creation**

**Product
Verification**

**Oven
Verification**

ThQM

Profiling A to Z

SMG SPC 201

Verification 101

SMG SPC 101

M.A.P. 201

OvenRIDER®

M.A.P. 101

WaveRIDER®

SMG SPC 301

M.A.P. 301

OvenCHECKER®



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Thermal Quality Management

Reduce Scrap and Increase Yields

Requirements

Stage 1 Define Requirements

Why do we profile?

- Identify heat sensitive components
- Choose soldering technology

Characterization

Stage 2 Machine Recipe Development

What is the oven recipe?

- Develop machine settings required for production that meet the above requirements
- Assure all solder joints experience the required temperature profile
- Assure sensitive components do not experience long term damage

Verification

Stage 3 Collect Data

How are we doing?

- Assure the temperature profile developed during characterization is being repeated
- Proof your thermal process is in control





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- **Glossary of SPC Terms**
- **Basic overview: Cp & CpK**
- **Applying them in SMG SPC Software**
 - Adding SPC Tabs
 - Spec Limits
 - Control Limits
 - SPC Tab
 - Spreadsheet Filtering revisited



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Glossary of SPC Terms

- **Measurement (X)**
- **Maximum**
- **Minimum**
- **Number (n)**
- **Average (\bar{X})**
- **Mean (μ)**
- **Standard Deviation**

$$s = \sqrt{\frac{\sum_{i=1}^n (X_i - \bar{X})^2}{(n-1)}}$$



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Glossary continued

- **Sigma σ**
- **Average of Average ($\bar{\bar{X}}$)**
- **USL**
- **LSL**
- **UCL = $\bar{\bar{X}} + A_2 * \bar{R}$**
- **LCL = $\bar{\bar{X}} - A_2 * \bar{R}$**
- **Range (R)**
- **Range UCL = $D_4 * \bar{R}$**



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Glossary continued

➤ Capability Measures

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

$$C_{pk} = \min\left(\frac{USL - \mu}{3\sigma}; \frac{\mu - LSL}{3\sigma}\right)$$

➤ Normal Distribution

$$\frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{(X - \mu)^2}{2\sigma^2}}$$



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Glossary continued

Constants for calculating Control Limits

Observations
In Sample

Factors for Control
Limits

A_2

D_4

2	1.880	3.267
3	1.023	2.574
4	0.729	2.282
5	0.577	2.114
6	0.483	2.004
.
.
.

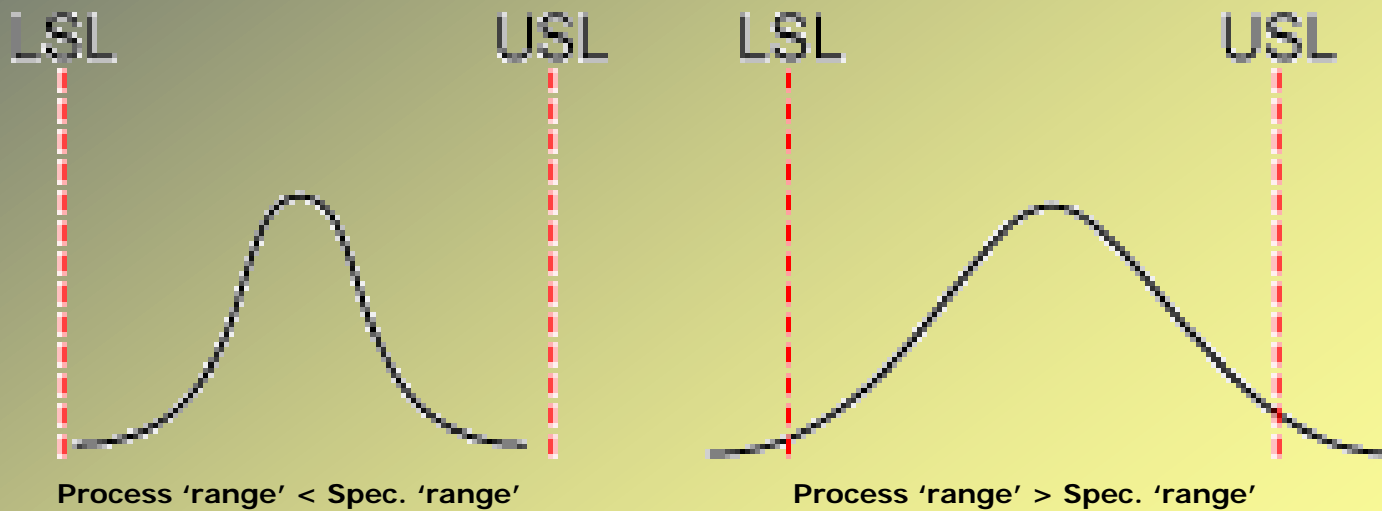


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C_p

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

The value of C_p is the difference between your specification limits (USL - LSL) divided by six times the standard deviation of the distribution.



Note: High C_p does NOT imply that the process distribution is at all centered re: Specification

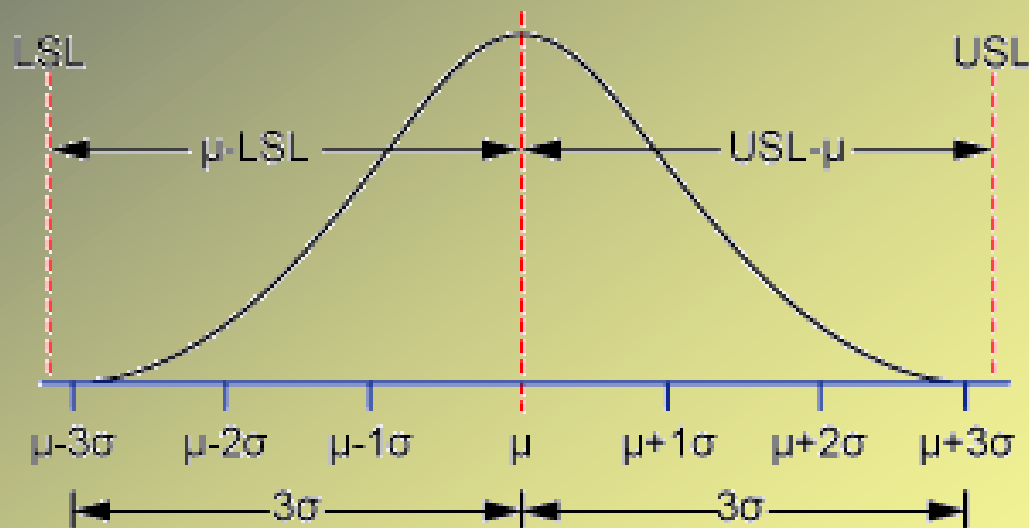


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CpK

$$Cpk = \min\left(\frac{USL - \mu}{3\sigma}; \frac{\mu - LSL}{3\sigma}\right)$$

The value of CpK is the difference between the average (μ) of the measured values (x) and the nearest specification limit (LSL, USL) divided by three times the standard deviation (σ).



Note: High CpK indicates the degree to which the process distribution is within Spec. limits



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Adding SPC Tabs

- Drag and drop
- Enabling tabs
- Naming tabs



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Spec Limits

- Process tolerance
Applies to each individual measurement

- Impact the Process capability



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Control Limits

- Calculated by the measurements
- Applied to the average of two or more measurements
- Fix or Not?



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SPC Tab (s)

- X-Bar R Chart
- N
- Min
- Max
- X-Bar
- Standard deviation
- Cp
- CpK



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Spreadsheet Filtering revisited

- Spreadsheet Data is the source for SPC calculations
- SPC only works when data comes from same process



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Thank you for attending today's session.

Questions?

Contact support@ECD.com

Visit www.ecd.com/ecdu/

ECD Technical Support 503-659-6100