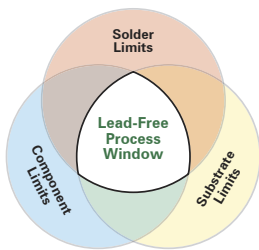


# Lead-Free New Problems - New Solutions

Over the past several decades the electronics assembly industry has perfected efficient and high quality manufacturing of leaded assemblies. Today we are faced with disruptive changes required by the production of Lead-Free electronics. Manufacturers are discovering that their old, tried-and-true methods no longer work. After selecting new lead-free materials and implementing new logistical systems, controlling thermal process variation is the remaining critical issue. Managing the radically different and narrow thermal process window requires fresh thinking, new procedures, and innovative technologies.

## The Thermal Process

The very narrow thermal process window is the result of three intersecting process windows: solder, components and substrate.



Most popular SAC alloys melt at 217°C compared to 183°C for typical leaded solder pastes. Poor wetting properties of lead-free solder force strict adherence to new soak and TAL specifications. Peak temperatures above 250°C—and in some cases as low as 240°C—are potentially destructive to temperature-sensitive components such as certain IC's, crystals,

power amplifiers and more. Problems surrounding moisture sensitivity are also exacerbated. At higher temperatures, moisture trapped in a component body may turn to steam and escape, causing defective parts. Additionally, the substrate may delaminate, discolor, char and warp at elevated temperatures. To avoid such issues, the thermal process must strictly adhere to the relevant process window.

Since periodic profiling is inadequate, a systematic approach is needed to manage the thermal process based on measuring actual process data in real-time.

## Process Development

KIC recommends the analytical 3-step method: *Define, Measure, Improve*.

**Define:** The correct process window consists of the three process specs: solder, components and substrate. KIC's built-in library of process limits for hundreds of solders acts as the foundation for this step. The engineer modifies the solder supplier's specs based on the assembly's tolerances for the substrate and most sensitive components, and arrives at the correct process window.

**Measure:** Once defined, the process must be measured, thus providing a means for improvement. Based on actual profiles and process data—such as peak temperature—a profile is “fitted” to the defined process window using a statistical concept called the Process

Window Index (PWI). The PWI calculates how much of the available process window is utilized by each profile, and is reported as a percentage. The PWI scale: Center of process window = 0%; Edge of process window = 100%; Out of spec > 100%.

**Improve:** KIC's Auto-Focus *Oven Recipe Search Engine* automatically selects the “One Best” oven set up by literally reviewing billions of alternative oven settings within a few seconds. An engineer selects one of three possible options that influence the recommended set up:

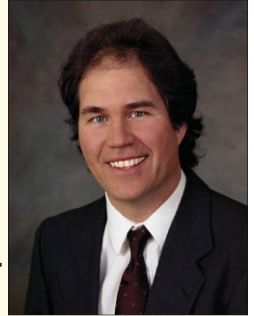
1. Position the process in the middle of the process window
2. Maximize throughput
3. Minimize changeover time

## Process Control

“A continuous production environment needs continuous monitoring to fulfill process control requirements,” states Lee Hudson, Manufacturing Engineer for Motorola.

The automated and continuous process monitoring system—KIC 24/7—provides critical information for every part that passes through the oven (i.e. *virtual profiling*). This includes all critical process data for the PCB (as opposed to data for the machine) as well as the profile's fit to the process specs (PWI number). Process stability is also displayed by its dynamic Cpk number. As the real-time data is collected, the KIC 24/7 will warn if the process drifts

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out of control and it will shut-down the feed conveyor if the process goes out of spec. This capability virtually ensures a zero-defect thermal process, whether for lead-free or standard applications.

## Key Capabilities

- Full process traceability down to the individual part.
- Real-time monitoring of the tight process associated with lead-free electronics.
- Elimination of periodic profiling.
- Automatic and continuous SPC functionality.

The narrow process window associated with lead-free applications nearly eliminates the margin for error. KIC selects the very best oven recipe while ensuring every single part is processed in spec—every day, all day. The process data can be retrieved at any time for years to come.

Lead-Free production is not difficult when you have the right thermal process tools!

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