APPLICATION NOTE

Durafuse® LT Reflow Process Optimization by Application

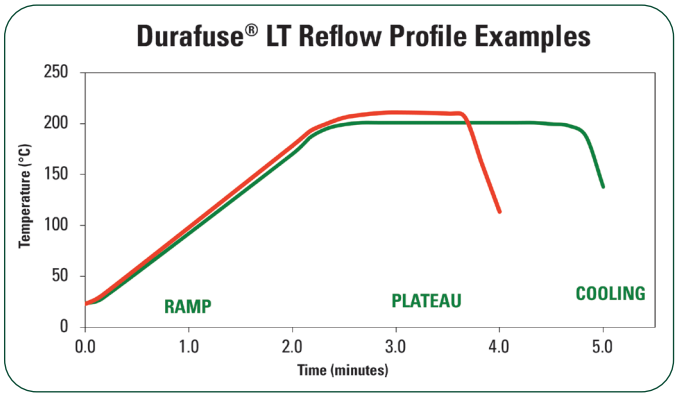
Introduction

Durafuse® LT is a patented novel solder paste mixed alloy system that is made up of a low melting point In-containing alloy and higher-melting SAC alloy. The low melting alloy initiates joint diffusion while the SAC alloy provides enhanced strength and durability.

Durafuse® LT serves as a high-reliability solution to several different application challenges employing a vast array of reflow processes to achieve different results. Durafuse® LT has a wide reflow process window and it is essential that the reflow parameters are optimized for the intended application.

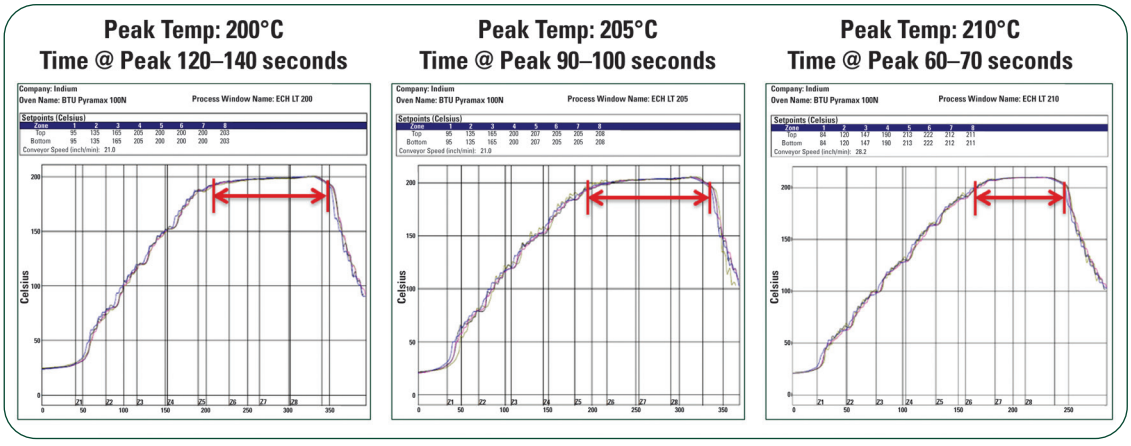
Durafuse® LT as a Mid-Temp Solution

When Durafuse® LT is used as a general mid-temp solution (reflowed lower than SAC305 but higher than BiSn) in applications including interposer processes, step soldering, heat sensitive components (excluding BGA warpage), rework, and re-balling, the recommended profile and parameters are shown below.



Profile Details	Recommended
Ramp Rate	0.5–2.5°C/second
Plateau Time at Peak Temp (TAP)	60–140 seconds
Peak Temperature	200~210°C
Cooling Ramp Rate	2–4°C/second

It is important to note that it is preferred to use a plateau style profile for Durafuse® LT to promote fusion of the mixed alloy and proper intermetallic formation. Durafuse® LT can be reflowed at multiple peak temperatures and an elongated plateau region is necessary to enhance its properties when using a lower peak reflow temperature.



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Durafuse® LT as a Solution for Warpage with Large BGAs

Durafuse® LT can be used as a solution for reducing HIP, NWO, and bridging due to large complex BGAs (>50mm square) with serious warpage. Some common application areas where this issue is prevalent are in the server, switch, infrastructure, and computing sectors.

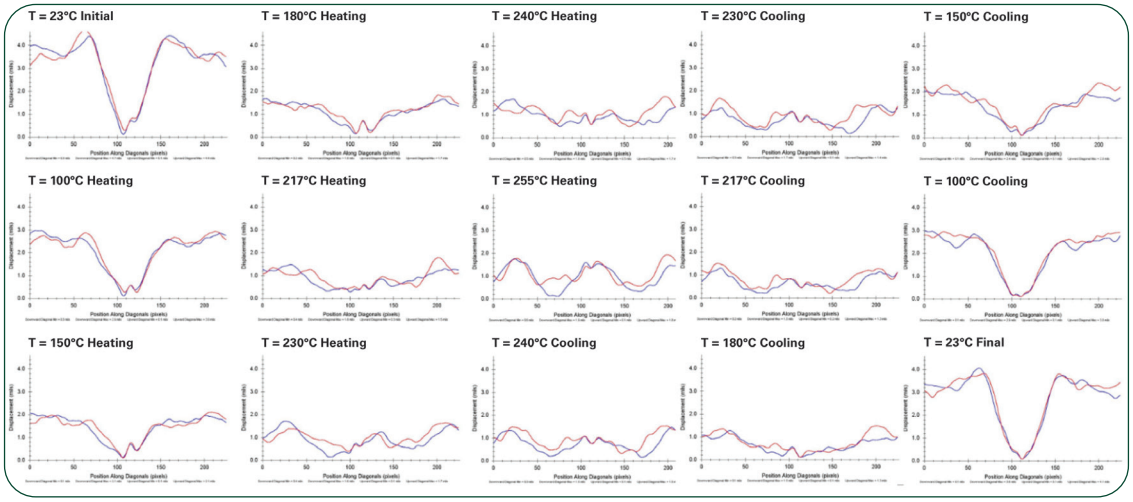
The figure below shows a shadow moiré diagram for BGA warpage at various temperature values in a typical reflow profile. At 210–220°C peak temperatures, the component flattens so that the balls come in contact with the paste and remain in contact.

For the stencil aperture design, a high paste-to-ball ratio is preferred (> 0.4:1) due to having lower melting point alloy to promote diffusion with the SAC balls at a lower temperature. More solder paste also assists in maintaining contact with the balls when warpage does occur. There may also be component warpage at time zero to contend with. The cooling rate should be as fast as possible to limit the amount of warpage in that stage. The recommended reflow parameters for using Durafuse® LT as a solution for mitigating BGA warpage defects is shown below.

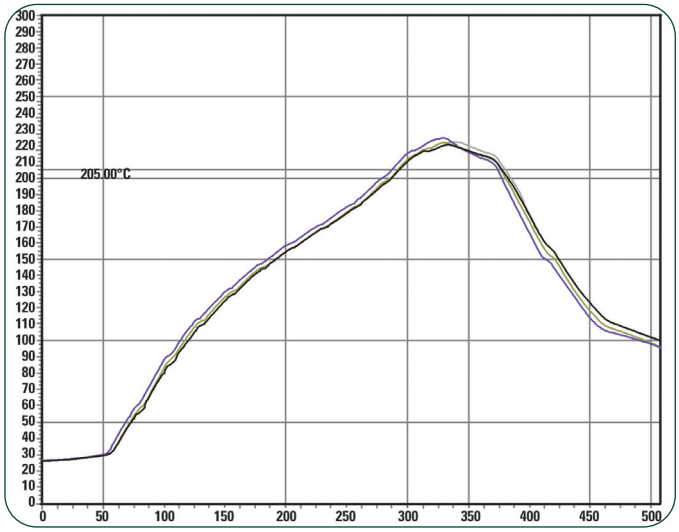
Profile Details	Recommended
Ramp Rate	0.5–2.5°C/second
Time Above 205°C	70–140 seconds
Peak Temperature	210~225°C (Large Size BGA)
Cooling Ramp Rate	1.5–4°C/second

The peak reflow temperature should ideally be 220°C to ensure the SAC ball fully diffuses with the paste to create a homogeneous solder joint. Real profile examples are shown at the bottom of the page.

Shadow Moiré Warpage Profile of Large BGA:



Reflow Profile Example:



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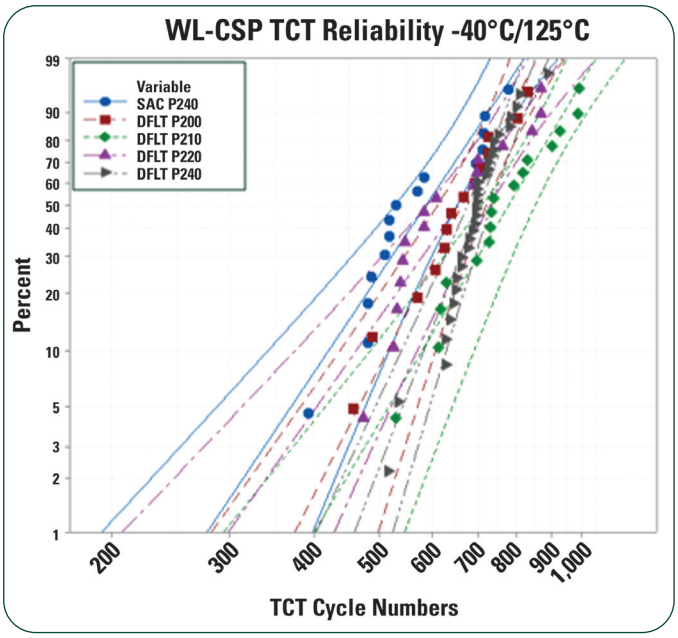
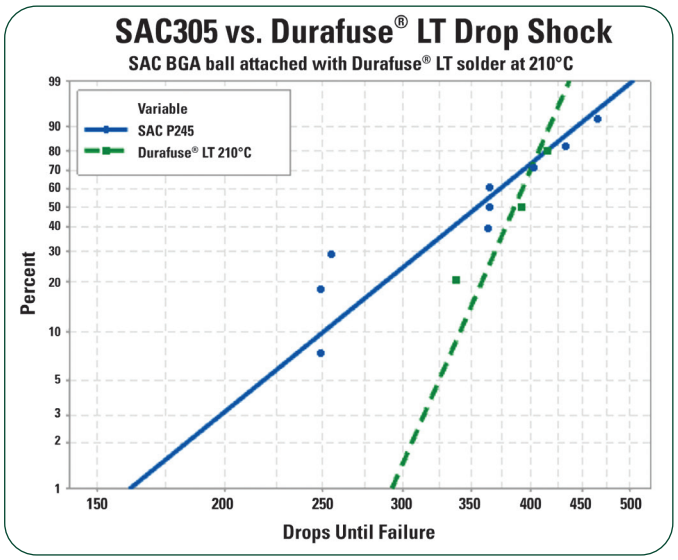
Durafuse® LT as a High-Reliability Solution (TCT)

Durafuse® LT can be used as a solution for improving Thermal Cycling Testing (TCT) reliability when there is a high CTE mismatch as typically seen with Wafer-Level CSPs which can exhibit early fatigue cracking in the mobile phone market.



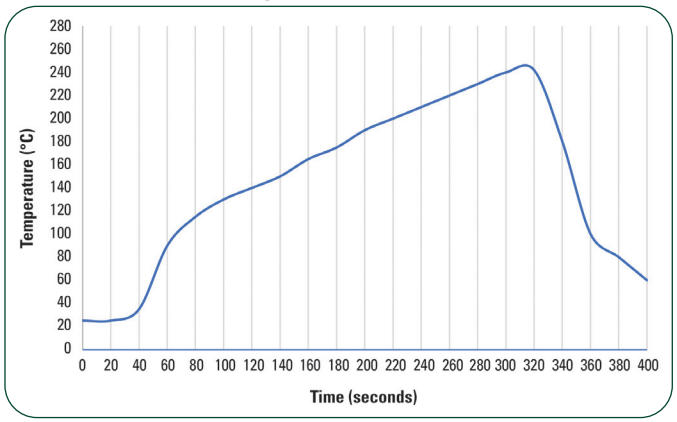
As shown in the Weibull plot for TCT reliability, Durafuse® LT can lead to an improvement over SAC305 over a wide range of peak temperatures. Durafuse® LT can also yield an improvement in drop shock reliability over SAC305.



The recommended profile parameters for when Durafuse® LT is used as a high-reliability solution are shown below along with a real-world profile.

Profile Details	Recommended
Ramp Rate	0.5–2.5°C/second
Plateau Time at Peak Temp (TAP	60–110 seconds
Peak Temperature	220~255°C
Cooling Ramp Rate	2–4°C/second
Remark	Lower peak, longer TAL

Reflow Profile Example:



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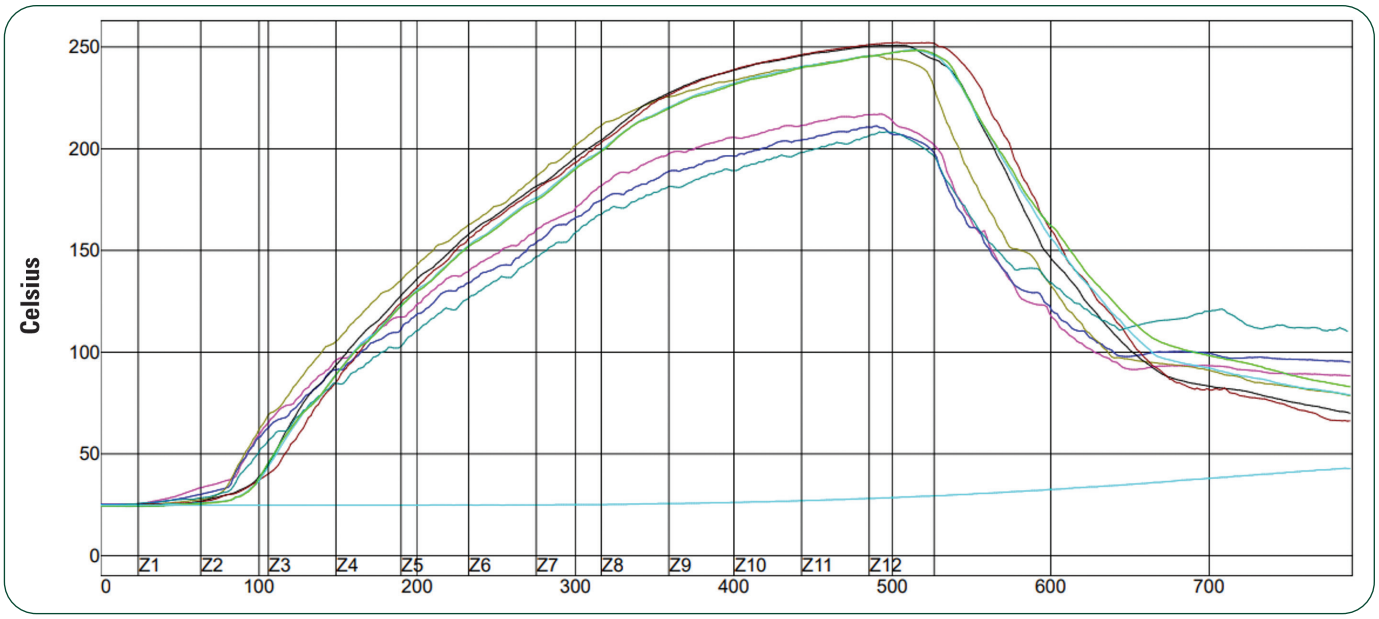
Durafuse® LT as a Large Temperature Gradient Solution

Durafuse® LT serves as a solution for complex assemblies with large thermally dense components as typically seen in applications with energy storage devices.

Hitting the profile targets for a typical lead-free profile can be a challenge for boards with large components due to the amount of heat they absorb, leading to the solder being at a much lower temperature for the smaller components on the board. When the temperatures in the oven are increased to accommodate the large components, the small components are subject to a much hotter temperature and can exceed the recommended maximum limits from the component supplier. Due to the large process window of Durafuse® LT, the large components are able to be reflowed at a much lower temperature without the need to push the limits of other components on the board. The recommended reflow parameters are shown below along with a real-world profile.

Details	Recommended
Ramp Rate	0.5–2.5°C/second
Higher Temp Smaller Components: Time Above Liquidus (TAL)	30–90 seconds
Lower Temp Larger Components: Plateau Time at Peak (TAP)	60–140 seconds
Peak Temperature	200~260°C
Cooling Ramp Rate	2–4°C/second
Remark	Lower peak, longer TAL

Reflow Profile Example:



Temperature/Time Recommendations:

Temperature (°C)	Time at Peak (s)
200	120–140
205	80–100
210	60-80
≥220	30–60

All of Indium Corporation's solder paste and preform manufacturing facilities are IATF 16949:2016 certified.
Indium Corporation is an ISO 9001:2015 registered company.

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