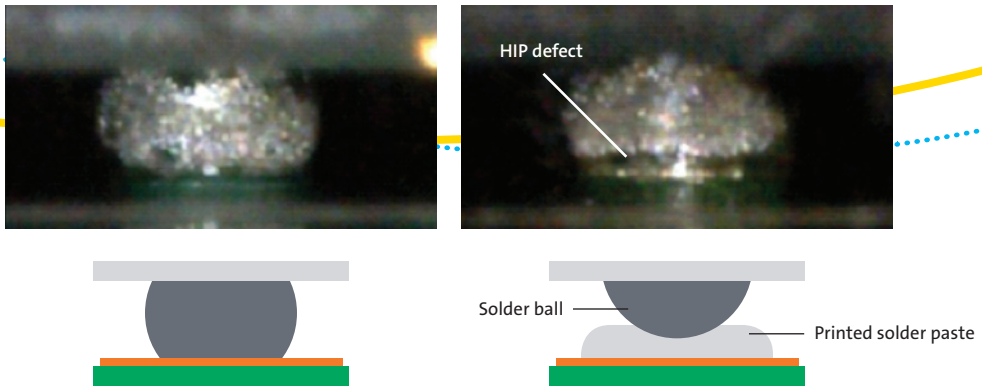
Nitrogen Reflow:

A solution for reducing head-in-pillow (HIP) defects and improving assembly reliability

Figure 1. Head-in-pillow (HIP) defects



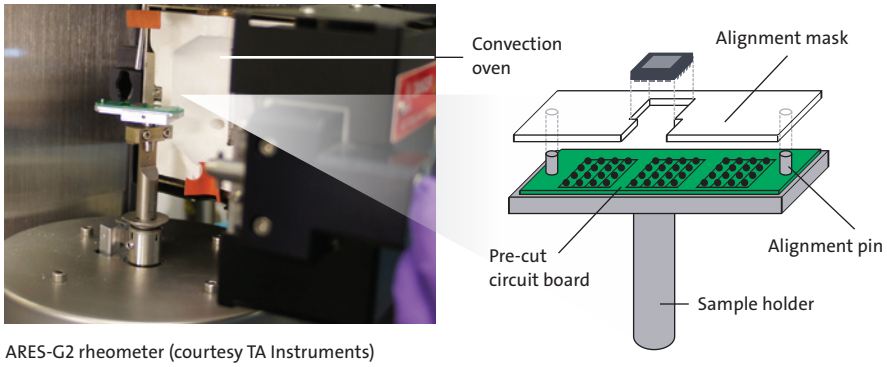
A good solder joint, left, and a joint with a HIP defect, right.

Building on our 25 years of proprietary and patented innovation for the global electronics packaging industry and our expertise in inert atmospheres for industrial gases, Air Products recommends nitrogen reflow as a solution for reducing head-in-pillow (HIP) defects and improving assembly reliability for BGA and CSP components.

Understanding HIP defects

A HIP defect—so named because in looking at the cross section of a solder joint, it looks like a head lying on a soft pillow—is an incomplete coalescence of the solder ball on a surface-mount component and printed solder past upon reflow (see Fig. 1).

Figure 2. Simulation of reflow process in nitrogen-inerted chamber



ARES-G2 rheometer (courtesy TA Instruments)

Air Products designed this experiment to visually demonstrate the benefits of nitrogen reflow using the convection oven of a rheometer for its inerting capability and straightforward temperature control. This setup was designed to accurately simulate the conditions met during a conventional oven reflow process. We used a soak temperature profile recommended by a solder past manufacturer. All nitrogen reflow experiments were conducted at a ~1400 ppm oxygen level.

HIP defects are becoming even more of an issue when it comes to reliability because of the technological challenges associated with the lead free solder RoHS compliance and increased assembly functionality and miniaturization.

Smaller-size devices increase the chance of oxidation at the solder ball and solder paste interface, or at the board pad finishes. This metal surface oxidation is a major contributor to the formation of HIP defects, which typically occurs due to poor wetting or warping of a component upon heating, preventing metallurgical contact.

Nitrogen reflow for HIP defect reduction

In a study conducted by Air Products (see. Fig. 2), the reflow process of BGA and CSP components under a nitrogen (reduced oxygen) environment while using a low activity rosin-based paste, demonstrated better wetting performance than under an air reflow environment.

Nitrogen reflow prevented the formation of new oxides, while avoiding the use of solder pastes with high fluxing capacity, providing improved wetting performance, fewer HIP defects, and improved quality and cleanliness of the solder joints, as compared to a conventional air reflow process (see Fig. 3).

Similar results were obtained in nitrogen vs. air reflow tests conducted by Alpha/Cookson, a leading supplier to the global electronics packaging industry (see Fig. 4).

The benefits of nitrogen reflow

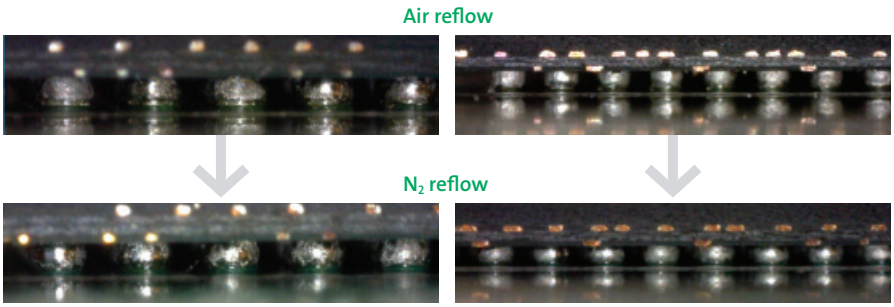
- Better wetting performance than air reflow
- Prevention of new oxides formation
- Avoidance of high-activity solder pastes
- Reduced number of HIP defects
- Improved quality and cleanliness of the solder joints

Contact us today

We welcome the opportunity to show you how nitrogen reflow can improve your electronics packaging applications. Please call 800-654-4567 or visit our website.

Corporate Headquarters
Air Products and Chemicals, Inc.
7201 Hamilton Boulevard
Allentown, PA 18195-1501
T 800-654-4567
F 800-272-4449
gigmktg@airproducts.com

Figure 3. Reduced head-in-pillow (HIP) defects upon N_2 reflow

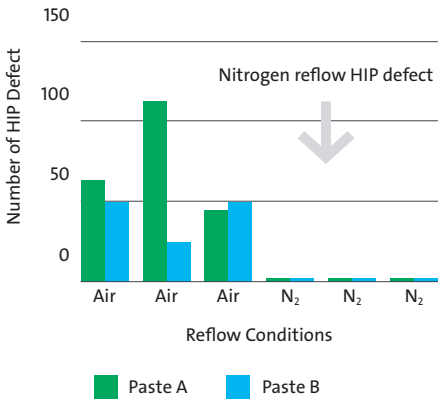


0.8 mm pitch BGA component

0.5 mm pitch CSP component

These comparative photos show the effectiveness of reflowing a 0.8 mm pitch BGA component, left, and a 0.5 mm pitch CSP component under nitrogen vs. air. Reflowing under nitrogen resulted in faster formation of cleaner solder joints with few, if any, HIP defects.

Figure 4. Effect of reflow atmosphere on HIP defect



Tests conducted by Alpha/Cookson, a leading supplier to the global electronics packaging industry, provide further evidence of the dramatic decrease in HIP defects using nitrogen reflow.

AIR PRODUCTS

tell me more

airproducts.com/electronics_assembly