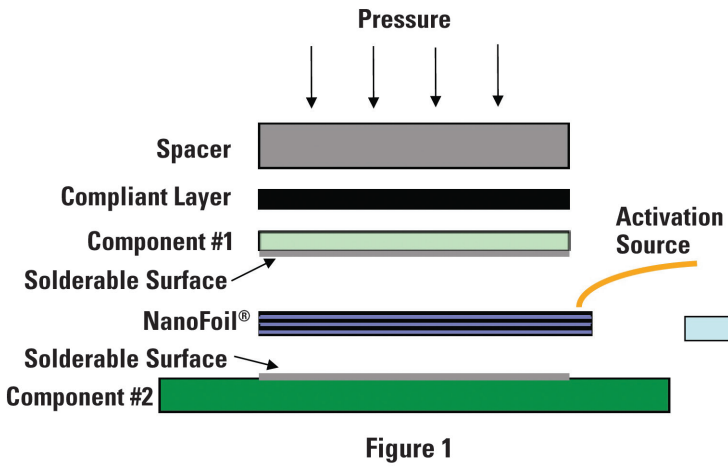
APPLICATION NOTE

NanoBond®: The Process for Using NanoFoil®

Introduction

NanoBond® is the process of bonding two components with solder using **NanoFoil®** as a heat source. When activated, the foil creates a self-sustaining reaction that acts as a rapid and controllable localized heat source to melt adjoining solder layers, bonding components together. Processing details vary with components, but some basic bonding details are:

- **NanoFoil®** selection and sizing
- The 3Ps—plating, planarity, and pressure
- **NanoFoil®** activation



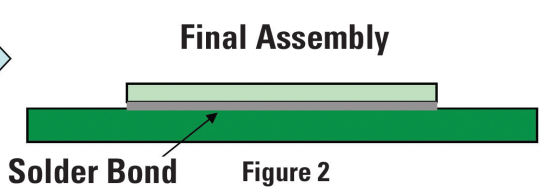


Figure 1.

NanoFoil Selection and Sizing

NanoFoil is available as:

- **Standard NanoFoil®**—a localized heat source that, when combined with solder performs or a solder-coated surface (<450°C), can be used to join two materials together.
- **Tin-Plated NanoFoil®** - standard **NanoFoil®** coated with 10µm of pure tin on both sides. Tin-plated **NanoFoil®** only requires solderable surfaces to create a bond.

The **NanoFoil®** should match the size and shape of your bondline, with the exception of exposed foil for activation if necessary (see the section on **NanoBond® Activation**, next page). The foil should be oversized 1mm for any holes, or undersized 1mm for any edges that need to be clear of solder to prevent overspray of solder and foil material.

NanoFoil® Availability and Properties*

Standard Thicknesses (µm)	40, 60
Tin-Plated Thickness (µm)	40, 60
Minimum Available Size	1 x 1mm
Composition After Reaction	$Ni_{50}Al_{50}$
Heat of Reaction	1,050–1,250J/g
Maximum Reaction Temp	1,350–1,500°C
Thermal Conductivity	35–50W/mK

**Please contact Indium Corporation for safety and handling.*

From One Engineer To Another®

Form No. 98626 (A4) R1

APPLICATION NOTE

NanoBond®: The Process for Using NanoFoil®

The 3 Ps: Plating, Planarity, and Pressure

Plating: Two Solderable Surfaces

A solderable surface is a surface to which solder will flow and wet without the help of flux. A solderable surface is necessary for both standard and tin-plated **NanoFoil®**.

Some recommended solderable finishes are:

- ENIG <1 micron
- Gold- or silver-plating: 1–15µm
- Solder-plating: 10–15µm
- Hot plate soldering: 10–250µm

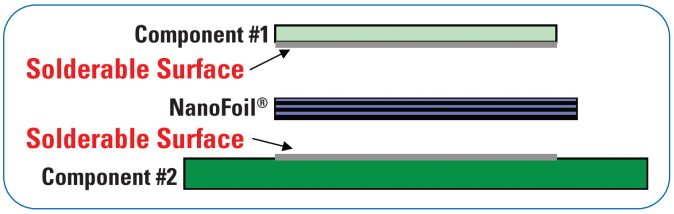


Figure 2.

This table matches the component surface finishes with the recommended **NanoFoil®** types. **NanoFoil®** thickness is determined based on solder and component type, composition, and sensitivity.

Recommended NanoFoil®	Component #1 Plating	Component #2 Plating
Tin-plated	ENIG, Au, Ag	ENIG, Au, Ag
Tin-plated	ENIG, Au, Ag	Solder-plated
Standard using solder preforms*	ENIG, Au, Ag	ENIG, Au, Ag
Standard	Solder-plated	Solder-plated

**Solder preforms can be used with NanoFoil® and appropriate surfaces.*

Planarity: Two Flat Surfaces

Another key component for a successful **NanoBond®** is the planarity of the components relative to one another and to the **NanoFoil®**. **NanoFoil®** can accommodate bowing up to 0.1% of the overall length in one or both of the components. Since the **NanoFoil®** reaction occurs in less than 5 milliseconds, flatter bonding surfaces will ensure better contact with the foil and prevent voiding or uneven bonding. In addition, flatter components will require less applied pressure to create a good bond (see Figure 3).

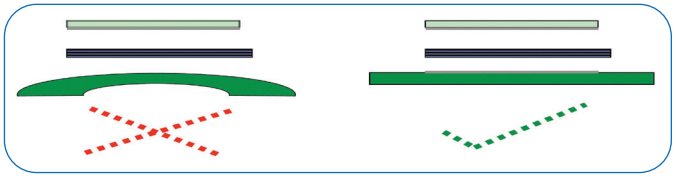


Figure 3.

Pressure and Alignment

The pressure application requires three components: adequate pressure, uniform pressure, and constant pressure.

- Adequate Pressure: A spacer should be used to step the pressure to the size of parts being joined; actual pressure depends on planarity and part sensitivity.
- Uniform Pressure: A compliant layer, such as foam, should be used to spread the load. We recommend 2# EVA Foam from Rubberlite.
- Constant Pressure: Since solder will be molten for a few milliseconds during activation, constant feedback pressure from a **hydraulic**, **air**-driven, or **mechanical**-driven (spring) press or fixture is required.

Alignment is also an important part of the activation process as parts can shift during activation if they are not properly aligned (see Figure 1 on the front page).

NanoFoil Activation

NanoFoil® can be activated with a small pulse of local energy applied using optical, electrical, or thermal sources. Applying energy at a local point is just as important as the amount of energy applied.

- Thermal: Soldering iron or 250°C temperature
- Electrical: Resistance soldering iron or a battery (50 watts of power)
- Optical: Laser

NanoFoil® must be in direct contact with the energy source when activated. In most cases, this requires oversizing the foil or cutting a tab in the foil. However, once activated, foil outside of the bond will leave a brittle metallic alloy that may need to be cleaned. Sizing the **NanoFoil®** to the exact bondline and activating it with a laser or fine wire will eliminate this post-reaction material.

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.

Contact our engineers: askus@indium.com
Learn more: www.indium.com

ASIA +65 6268 8678 • CHINA +86 (0) 512 628 34900 • EUROPE +44 (0) 1908 580400 • USA +1 315 853 4900