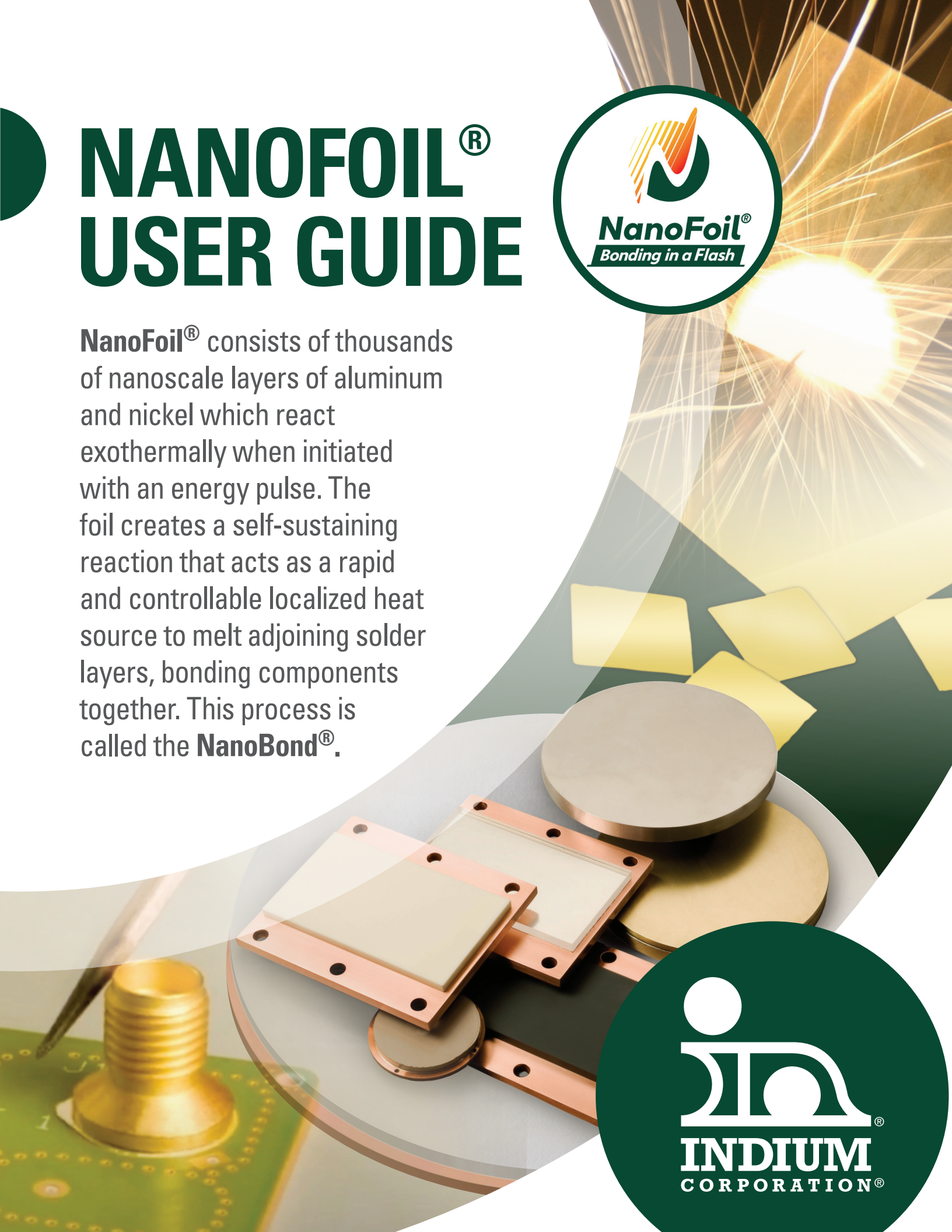
# NANOFOIL® USER GUIDE

NanoFoil® Bonding in a Flash

**NanoFoil®** consists of thousands of nanoscale layers of aluminum and nickel which react exothermally when initiated with an energy pulse. 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. This process is called the **NanoBond®.**



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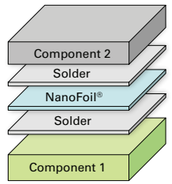
## NanoBond® Process

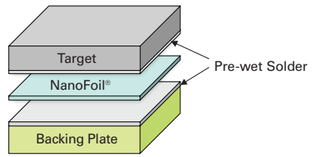
### Step 1: Configuring the bond interface structure

NanoFoil® is placed between two components that need to be bonded, along with two layers of solder.

a. **Freestanding solder preforms or solder-plated foil components** are used when components are Au-metallized, easy to wet, or have low thermal conductivity.




b. **Solder pre-wet onto the components** is used when the components are difficult to wet or have high thermal conductivity.

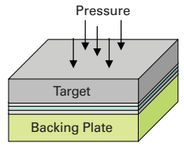



### Step 2: Prepare the surfaces

Component surfaces should be flat (machined or conditioned), smooth, and clean. In configurations where the components are not pre-wet with solder, it is necessary to remove the surface oxide through plating or etching. A 10% HCl solution is usually sufficient to remove oxides from components and solder.

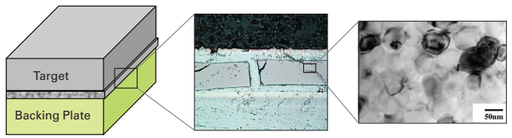
### Step 3: Alignment and pressure

To ensure proper wetting of the component surfaces, it is important to properly align the solder, NanoFoil®, and components. Apply the proper amount of pressure to the components to allow the molten solder to flow and properly wet the component surfaces. For instance, when using components pre-wet with indium solder, use proper psi. A spring is recommended to apply a constant pressure throughout the joining process.




### Step 4: Activate the NanoFoil®

The NanoFoil® is designed to chemically react and give off heat to melt the solder. The NanoFoil® can be activated with a small pulse of local energy, which can be applied using optical, electrical, or thermal sources.




## NanoFoil® Cutting Procedure

### Personal Protective Equipment

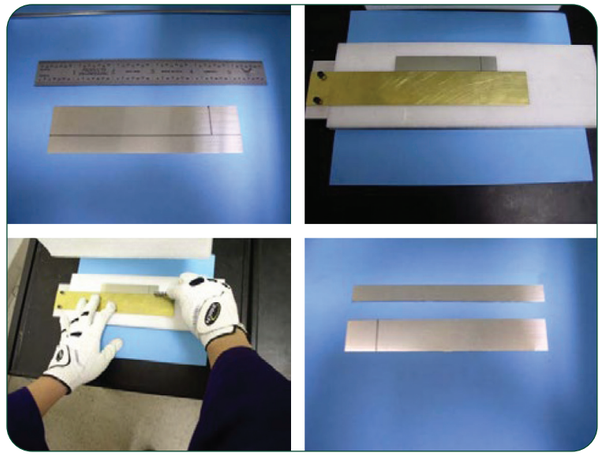
- Safety glasses
- Leather gloves

### Additional Supplies Needed

- Glass cutter with carbide wheel
- T-square

### Procedure

1. Measure and draw the lines for the desired geometry on the NanoFoil®. Add a slight margin to compensate for the cutting loss. It is also advisable to make the larger cuts along the striations of the foil, as it is easier to cut along the striations than against them.
2. Place NanoFoil® on a flat surface, preferably a plastic cutting board. Place the T-square on top of the NanoFoil® along one of the drawn lines.
3. Place the carbide wheel on top of the drawn line.
4. With one hand, press down on the T-square to hold the NanoFoil® in place.
5. With the other hand, roll the glass cutter back and forth while pressing down firmly to cut along the drawn line. It may take more than one pass until the NanoFoil® is cut completely.
6. Repeat steps 4 and 5 until the NanoFoil® is completely cut to desired geometry.
7. Pen markings can be wiped off using methanol.



## Ignition Suggestions

### Electrical Ignition

- To ignite the foil with a momentary point contact from an electrical probe, 10A and 5V is sufficient.
- To ignite the foil using ohmic heating, the current must be 100–120A for a 15µm contact diameter and 250–300A for a 300µm contact diameter.

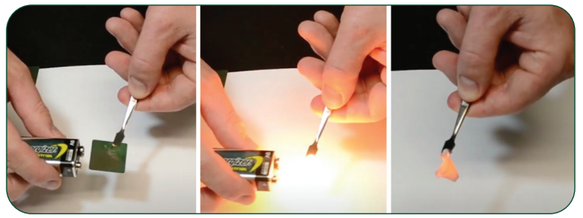
### Laser Ignition

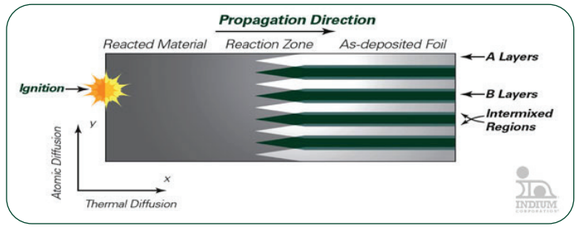
Below is a table of conditions for various laser types that will consistently ignite the NanoFoil®.

| Laser Type | Pulse Duration (sec) | Spot Diameter (µm) | Pulse Power (mJ) |
|---|---|---|---|
| YAG laser: wavelength 1064nm, pulsed | 8 x 10-9 | 100 | >300 |
| YAG laser: wavelength 1064nm, pulsed | 8 x 10-9 | 50 | >50 |
| YAG laser: wavelength 1064nm, pulsed | 8 x 10-9 | 10 | >10 |
| $CO_2$ laser: 200w, wavelength 10600nm continuous | 3 x 10-4 | 100 | – |
| IPG: 100w, wavelength 1085nm, continuous | 1 x 10-4 | 50 | – |
| IPG: 50w, wavelength 1085nm, continuous | 5 x 10-4 | 100 | – |

- NanoFoil® can be ignited with many other concentrated energy sources, such as a hot filament or flame.
- NanoFoil® will ignite when heated to 200°C at a heating rate of 200°C/min using any heating method.

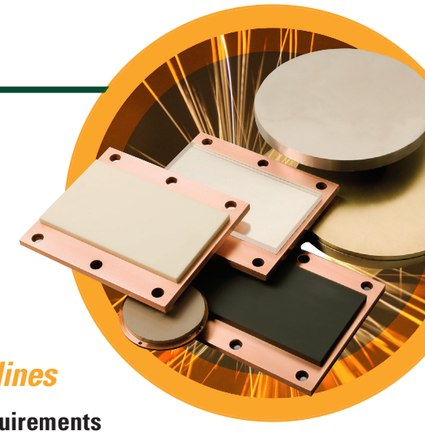
*Note: If heated too slowly, the NanoFoil® will anneal, losing its ability to create a self-sustaining reaction.*






## Technical and Sales Support

**Ronnie Spraker**
Product Support Manager, NanoFoil® Engineering



## Storage and Handling Guidelines

### General Safety Requirements

- Never handle NanoFoil® with bare hands. Always use non-pointed tweezers or heat-resistant gloves.
- When working with NanoFoil® wear safety glasses at all times.
- Do not use in the vicinity of solvents or flammable items.
- Keep unreacted NanoFoil® covered and away from the joining area.
- Do not store NanoFoil® in the joining area.
- All unused NanoFoil® must be placed in a fire-retardant bin for proper disposal.
- When bonding with NanoFoil®, wear cotton gloves and long sleeve shirts to prevent burns caused by solder spray.

### Handling Recommendations

- NanoFoil® can be applied manually using tweezers.
- NanoFoil® can also be handled by pick and place equipment.
- Always transport NanoFoil® in its container; the impact from falling may activate the foil.

### In Case of Fire

NanoFoil® will react completely and virtually instantaneously, generating large quantities of heat, but no flame. The primary fire hazard is the ignition of surrounding flammables. If any of the foil is in the midst of other burning materials, use the appropriate extinguishing agents for those materials.

### Storage

Shelf life is 12 months after date of shipment when stored in its original unopened container in a cool, dry environment between 60°F and 75°F (15.5–23.5°C). The location must be approved for flammable materials.

### Shipping

NanoFoil® is regulated by the Department of Transportation as a hazardous material (flammable solid) and subject to the regulations in 49 CFR. Do not ship without proper training.

## Safety Data Sheets

Please refer to the SDS document within the product shipment, or contact our local team to receive a copy.



INDIUM CORPORATION®

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## Our Goal

Increase our customers' productivity and profitability through the design, application, and service of advanced materials.

## Corporate Quality Policy

- Provide quality products that meet or exceed customer needs, expectations, and requirements
- Create an organizational culture that focuses on meeting requirements and continuous improvement
- Have products that are compliant with relevant laws and regulations
- Focus on defect prevention
- Respond to input from external and internal customers
- Identify and provide necessary resources

## Our Basis for Success

- Excellent product quality and performance
- Technical and customer service
- Cutting-edge material research and development
- Extensive product range
- Lowest cost of ownership

**World-Class Engineering, From Design to Production**

## Global Technical Support and Facilities Worldwide


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

*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.*

**From One Engineer To Another®**



Form No. 98563 R6