

# PRODUCT DATA SHEET

# WS-829

## Halogen-Free Ball-Attach and LED Die-Attach Flux

### Introduction

**Ball-Attach Flux WS-829** is a halogen-free water-soluble ball-attach and LED die-attach flux designed for use in pin transfer and printing applications for ball-attachment to substrates (BGA manufacturing) and wafer/panel (WLP/PLP manufacturing). **WS-829** can also be used for LED die-attach application. Its thixotropic property allows it to be printed on a substrate consistently with superb print definition for very small deposit without slumping. Its rheology is specifically designed for use with even the smallest gravity-fed spheres. **WS-829** has an activator system powerful enough to promote wetting on the most demanding substrate metallizations. Flux residue of **WS-829** can be effectively cleaned with just DI water only without leaving any contamination behind.

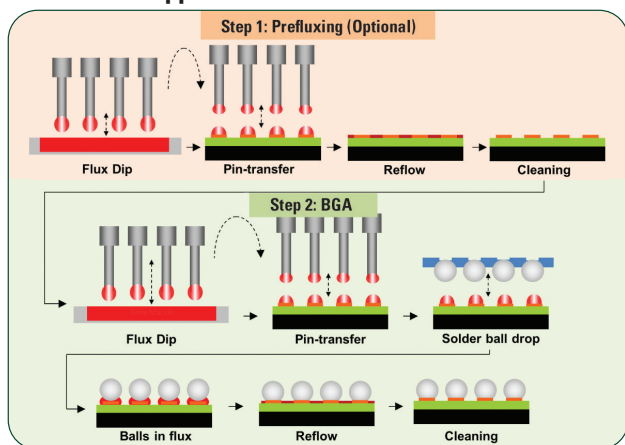


### Features

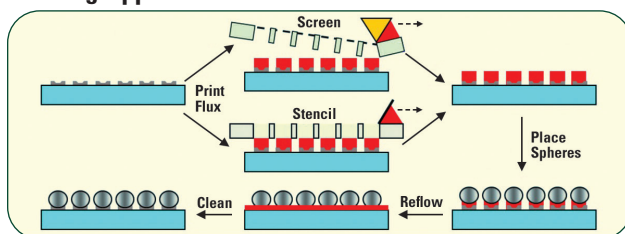
- Designed for ball-attach process, pin transfer, and printing applications
- Also suitable for miniLED or microLED die-attach application, printing through stencil for ultrafine aperture
- Halogen-free—per IPC and IEC specifications
- Flux rheology suitable even for smallest sphere size
- Thixotropic property ensures good print definition with minimal slump
- Promotes excellent solderability and wetting on a wide range of surfaces
  - Good results on AuNi and even on oxidized Cu-OSP (up to 0.3mm thick OSP)
- Promotes strong, low-voiding joints
- Cleans well with room temperature DI water
  - Saves money on water heating
  - No undesirable flux residue or contamination
- Designed for Pb-free applications
  - Suitable for all high-tin solders
- Ensures consistent joint quality by providing consistent pin transfer and printing performance over extended periods
- Reduces “double ball” and “missing balls”
  - Maintains tackiness during heating, results in minimal sphere movement
- Reflows in air or nitrogen
- Stable at room temperature for up to 6 months

### Standard Ball-Attach Process

#### Pin Transfer Application



#### Printing Application



### Flux Properties

#### Industry Standard Test Results and Classification

|                                                      |                                               |
|------------------------------------------------------|-----------------------------------------------|
| Flux Classification                                  | ORH0                                          |
| Based on the testing required by IPC J-STD-004A.     |                                               |
| Halogen-free per IEC 61249-2-21, Test Method EN14582 | <900 ppm Cl<br><900 ppm Br<br><1,500ppm Total |

|                       | Value               | Test Method                             |
|-----------------------|---------------------|-----------------------------------------|
| Typical Viscosity     | 18kcps (5 minutes)  | Brookfield HB DVII±CP (5rpm)            |
| Typical Acid Number   | 84mg KOH/g          | Titration                               |
| Typical Tack Strength | 300g                | J-STD-005 (IPC-TM-650: 2.4.44)          |
| Shelf Life            | 0–30°C for 6 months | Viscosity change/microscope examination |

*All information is for reference only.  
Not to be used as incoming product specifications.*

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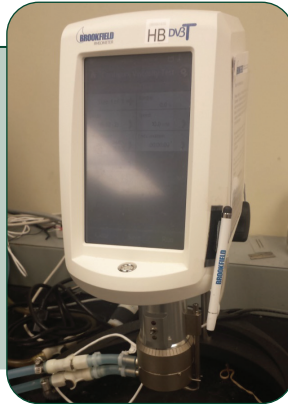
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## Pin Transfer

### Viscosity Test Method

- **Equipment**
  - Brookfield Cone & Plate
  - Model: DV3THBCB
- **Parameters**
  - Spindle: CP-51
  - Temperature: 25°C
  - Rpm: 10rpm



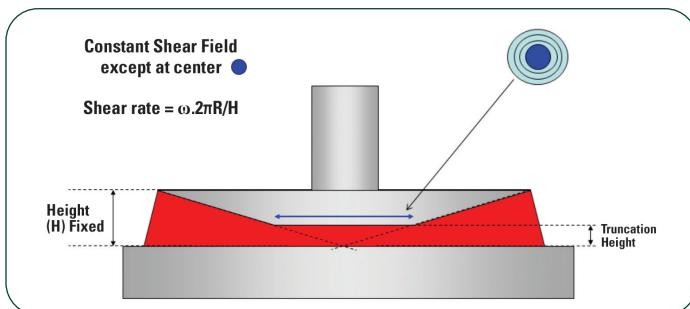
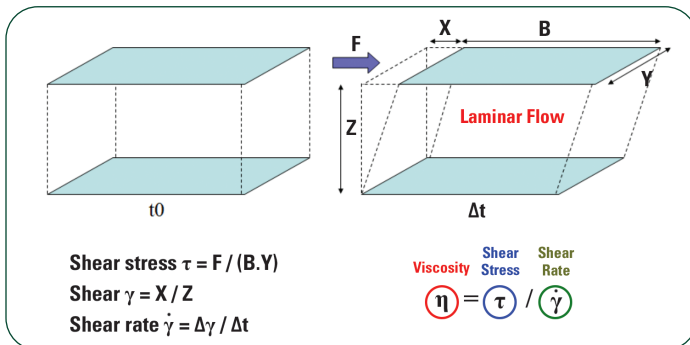
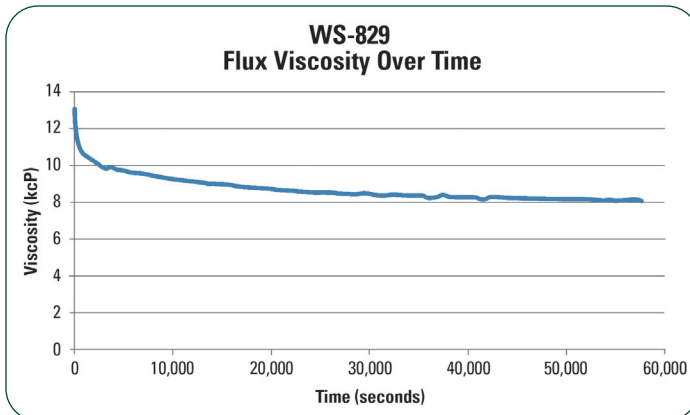
### Tack Test Method

- **Equipment**
  - Texture Technologies TA.XT2
- **Parameters**
  - Ambient Conditions
  - Humidity: 50% ± 3%
  - Room Temperature: 21.5°C ± 2°C

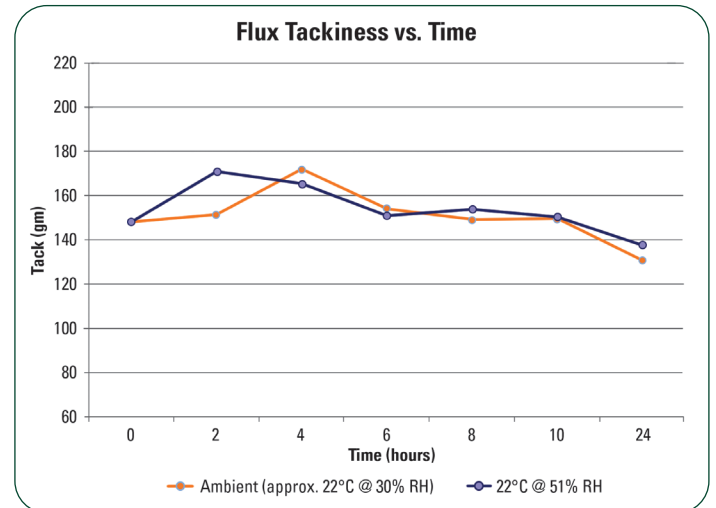


## Viscosity as a Function of Time

### Viscosity Controls



## Tack as a Function of Time



## Consistent Flux Deposition

WS-829's consistent viscosity and tack ensures consistent flux deposit sizes and eliminates missing ball before reflow.

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## Printing



### Printing Response-to-Pause (RTP) Test Method

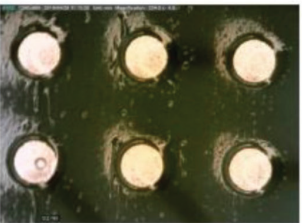
1. Knead 30 cycles @ 50mm/sec
  - a. Print one test board (0 hours)
  - b. Run a wet/dry/vac understencil wipe and pause for 1 hour
2. Knead 80 cycles @ 50mm/sec
  - a. Print one test board (1 hour)
  - b. Run a wet/dry/vac understencil wipe and pause for 1 hour
3. Repeat Step 2 another 3 times for printing test board at 2, 3, and 4 hours

### Consistent Printing Performance

Consistent printing performance over extended periods ensures good joint quality.

## Slump Test

- Inspect test boards from above test every 30 minutes for up to 2 hours

| Results                                                                              |                                                                                     |                                                                                     |                                                                                      |
|--------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| (Pictures at different time intervals are selected since all show minimal variation) |                                                                                     |                                                                                     |                                                                                      |
|                                                                                      | Initial Flux Printed                                                                | 60-Minute Flux Printed                                                              | 120-Minute Flux Printed                                                              |
| 0 Hours                                                                              |  |  |  |
| 2 Hours                                                                              |  |  |  |
| 4 Hours                                                                              |  |  |  |

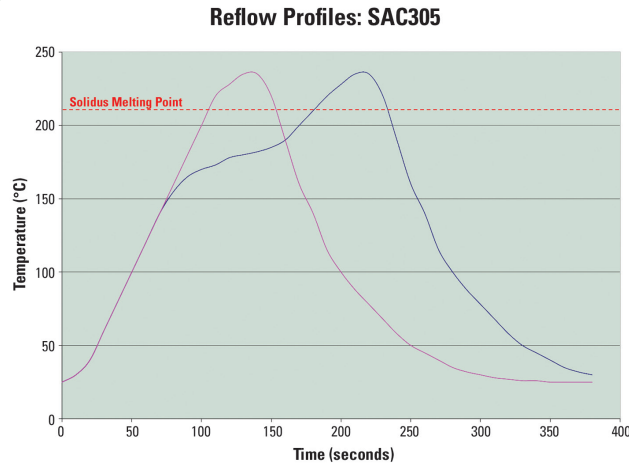
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# WS-829 Halogen-Free Ball-Attach and LED Die-Attach Flux

## Reflow

### Reflow

#### Recommended Profile:



**WS-829** is suitable for air and nitrogen reflow, and can work well in a variety of reflow profiles.

$$S_R = \frac{D-H}{D} \times 100 \dots \dots \dots (16)$$

where,  $S_R$ : spreading ratio (%)

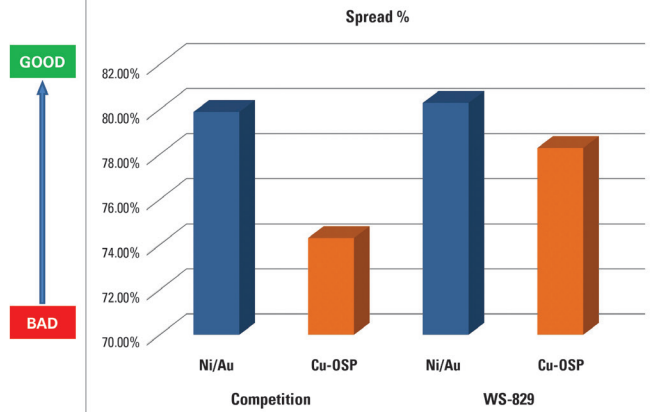
$H$ : height of the spread solder (mm)

$D$ : diameter of the solder, when it is assumed to be a sphere (mm)

$$D = 1.24V^{1/3}$$

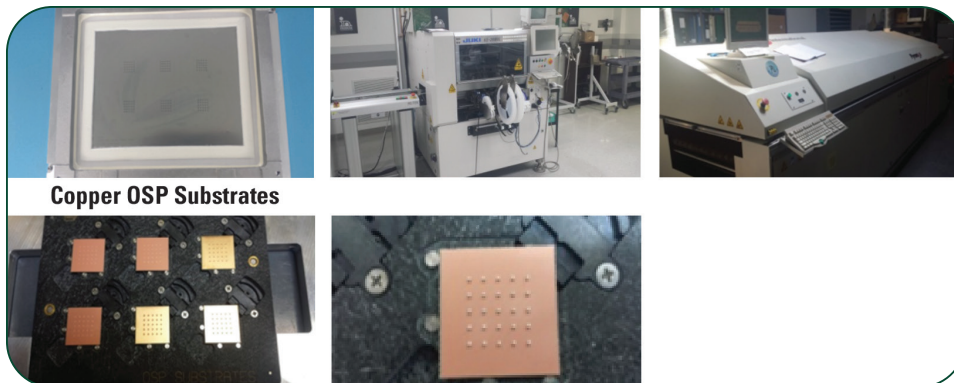
$V$ : mass ( $^{12}$ )/density of tested solder

### Wetting Comparison



## Eliminates Missing Ball and Increases Joint Strength

**WS-829** eliminates missing ball during reflow by high viscosity and rapid soldering. Joint strength is high due to good wetting.



## Solderability Test Method

- Print flux onto metallized surface
- Place spheres onto flux deposit
- Reflow (air or  $N_2$  [typical])
- Measure reflowed height deposit
- Calculate spreading ratio (wetting)

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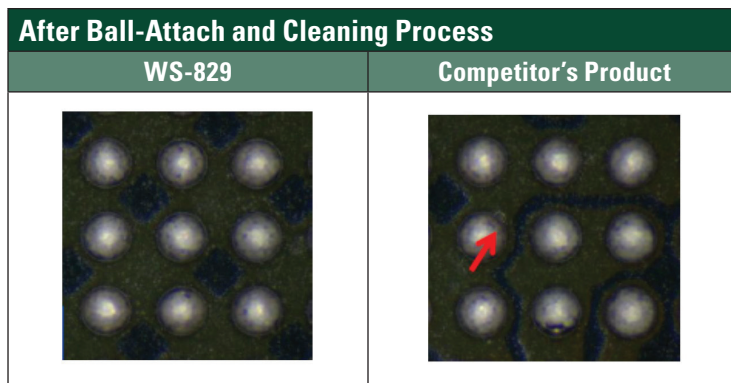
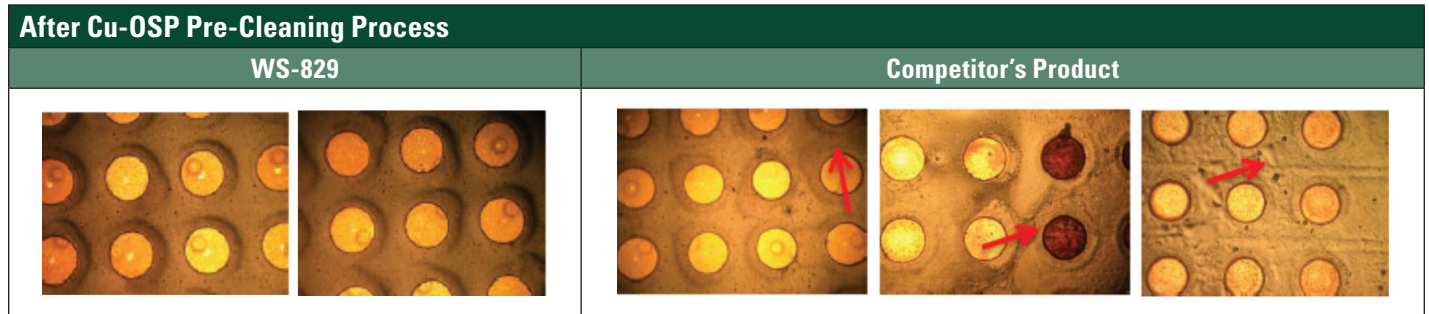


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# WS-829 Halogen-Free Ball-Attach and LED Die-Attach Flux Cleaning

## Cleaning Process

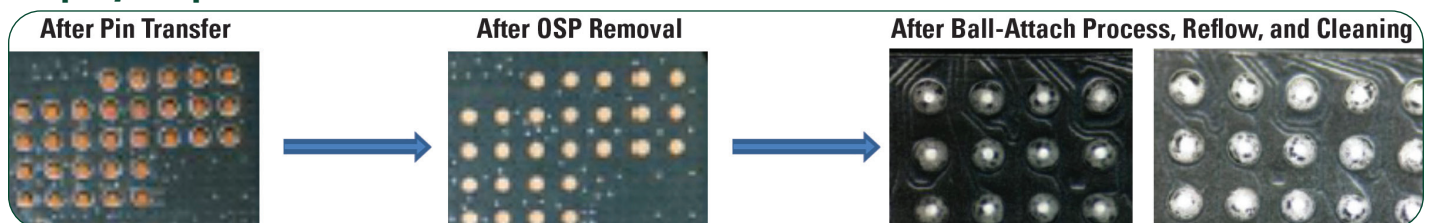
Using in-line DI water spray cleaning equipment



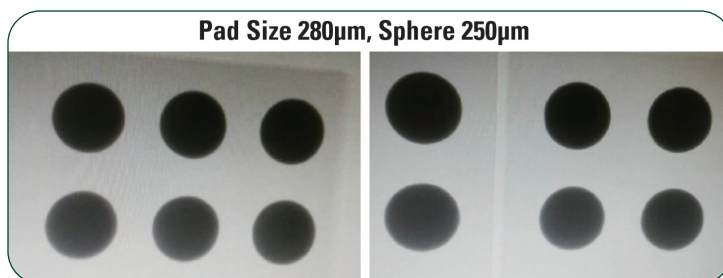
## Best-in-Class Cleanability

**WS-829** was able to remove Cu-OSP and most stubborn contamination on the substrate, and residue was easily removable with standard cleaning process.

## Step-by-Step Process



## Minimal Voiding



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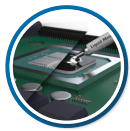
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# WS-829 Halogen-Free Ball-Attach and LED Die-Attach Flux

## Heterogeneous Integration & Assembly Materials



### Thermal Management

- TIM2 / Heat-Spring®
- TIM1

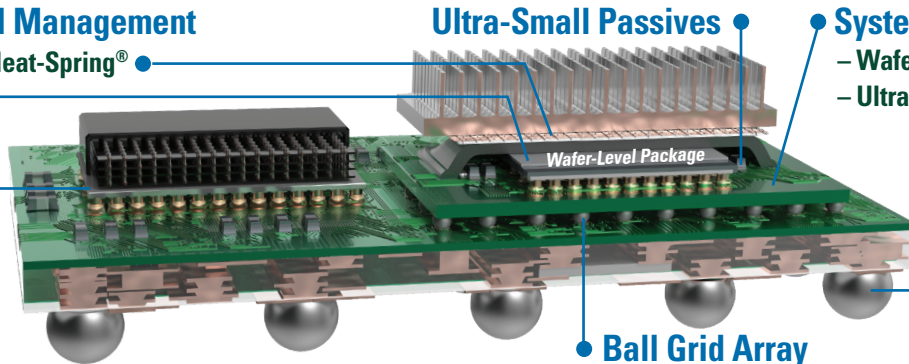
### Ultra-Small Passives

### System-in-Package

- Wafer-Level Ball-Attach Flux
- Ultrafine-Pitch Solder Paste

### Memory and Flip-Chip / 3D Logic

- Wafer Bumping (Bump Fusion) Flux
- Flip-Chip Flux



### SMT

- Solder Paste
- Solder Wire
- Solder Flux
- Preforms
- Bar Solder

### Ball Grid Array

- Ball-Attach Flux

## Recommended Semiconductor Fluxes and Solder Pastes

| Material Group | Material Type                             | Material Name   | Flux Type                                       | Halogen-Free | Application                          | Comments                                                                                                                   |
|----------------|-------------------------------------------|-----------------|-------------------------------------------------|--------------|--------------------------------------|----------------------------------------------------------------------------------------------------------------------------|
| FLUX           | Wafer Bumping Flux                        | SC-5R           | Solvent-clean                                   | Yes          | Spin coating                         | High Pb, Sn/Pb Eutectic and SnAg solder bumps                                                                              |
|                |                                           | WS-3543         | Water-wash                                      | Yes          | Spin coating                         | High viscosity for taller copper-pillars and larger bumps (>40 microns)                                                    |
|                |                                           | WS-3401         | Water-wash                                      | Yes          | Spin coating                         | Low viscosity for smaller pillars and bumps                                                                                |
|                | Wafer-Level or Panel-Level Packaging Flux | WS-676          | Water-wash                                      | Yes          | Printing                             | 0.5mm and smaller pitch wafer-level or panel level package                                                                 |
|                |                                           | WS-759          |                                                 |              |                                      |                                                                                                                            |
|                |                                           | WS-829          |                                                 |              |                                      |                                                                                                                            |
|                | Flip-Chip Flux                            | WS-575-SP       | Water-wash                                      | Yes          | Jetting/Spraying                     | Sn/Pb Eutectic and SnAg onto SOP for logic flip-chip                                                                       |
|                |                                           | FC-NC-HT-A1     | No-clean                                        | Yes          | Jetting/Spraying                     | Mass reflow flux compatible with CUF                                                                                       |
|                |                                           | WS-446          | Water-wash                                      | No           | Dipping                              | Best flux for poor solderability                                                                                           |
|                |                                           | WS-688          | Water-wash                                      | Yes          | Dipping                              | General purpose for multi-core logic flip-chip                                                                             |
|                |                                           | WS-641          | Water-wash                                      | Yes          | Dipping                              | For chip-on-wafer, high-density Cu-pillar application                                                                      |
|                |                                           | NC-26-A         | Ultra-low residue no-clean                      | Yes          | Dipping                              | Best compatibility with CUF/MUF                                                                                            |
|                |                                           | NC-26S          | Ultra-low residue no-clean                      | Yes          | Dipping                              | Avoids capillary flow up to die surface for fine-pitch devices                                                             |
|                |                                           | NC-699          | Near-zero residue                               | Yes          | Dipping                              | Controlled solderability, compatible with wide variety of CUF/MUF                                                          |
|                | Ball-Attach Flux                          | WS-446-AL       | Water-wash                                      | No           | Pin Transfer                         | Best flux for poor solderability                                                                                           |
|                |                                           | WS-823          | Water-wash                                      | Yes          | Pin Transfer                         | Best all-around halogen-free ball-attach flux, easily cleaned                                                              |
|                |                                           | WS-829          | Water-wash                                      | Yes          | Printing and pin transfer            | For sphere size <0.25mm and fine-pitch high-density ball-attach, best cleanliness                                          |
|                |                                           | NC-585          | No-clean                                        | Compliant    | Pin Transfer                         | Good wetting onto bare nickel for 0.5mm pitch or lower BGA/PGA                                                             |
|                |                                           | WS-575-C-RT     | Water-wash                                      | NIA          | Pin Transfer                         | Best ball-attach flux for missing ball<br>Eliminates the prefluxing step for OSP                                           |
|                | Flip-Chip and Ball-Attach Flux            | NC-809          | Ultra-low residue no-clean                      | Yes          | Dipping<br>Printing and pin transfer | Enhanced wetting, compatible with wide variety of CUF/MUF<br>Suitable for no-clean process, good wetting onto gold surface |
|                |                                           | WS-446HF        | Water-wash                                      | Yes          | Dipping                              | Best all-around halogen-free flip-chip flux, easily cleaned                                                                |
|                |                                           |                 |                                                 |              | Pin Transfer                         | Suitable for one-step Cu OSP process for sphere size 0.25mm and above                                                      |
| SOLDER PASTE   | Jetting Paste                             | PicoShot® WS-5M | Water-wash                                      | Yes          | Jetting                              | For dot jetting of 300µm diameter and above, and fine-line dispensing for metal lid-attach                                 |
|                |                                           | PicoShot® NC-5M | Solvent- or aqueous-based chemistry or no-clean | Yes          | Jetting                              | For dot jetting of 300µm diameter and above, and fine-line dispensing for metal lid-attach                                 |
|                |                                           | Indium12.8HF    |                                                 |              | Jetting and Microdispensing          | For dot jetting down to 80µm diameter and above, and fine-line dispensing for metal lid-attach                             |
|                | SiPaste® Solder Paste                     | SiPaste® 3.2HF  | Water-wash                                      | Yes          | Printing                             | Type 6, Type 7, and Type 8 solder paste suitable for ultrafine-pitch printing                                              |
|                |                                           | SiPaste® C201HF | DI water + saponifier or semi-aqueous chemistry |              |                                      |                                                                                                                            |
|                |                                           | SiPaste® SMQ77  | No-clean                                        |              |                                      |                                                                                                                            |
| OTHER          | Adhesive Solution                         | NC-702          | Minimal to no residue                           | Yes          | Dipping/Dispensing/Jetting           | Holding die, chip, and preform in place, for formic acid reflow                                                            |

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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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