PRODUCT DATA SHEET

Ultra-Low and Near-Zero Residue

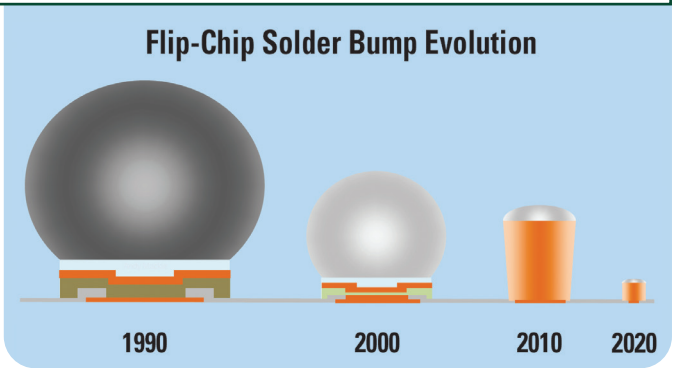
Flip-Chip Fluxes

Introduction

Indium Corporation's **Ultra-Low and Near-Zero Residue (ULR/NZR) Flip-Chip Fluxes** are halogen-free, no-clean dipping fluxes, designed to leave a very small amount of a benign, solid, clear residue after reflow. By reducing the residue quantity, the flux allows the flow of capillary or molded underfills (CUF/MUF) without underfill voiding, and its benign chemical nature optimizes the strength of the flux/underfill interface. By eliminating the cleaning process, these fluxes also eliminate the excessive stresses on the die and solder joints caused by every aspect of flux cleaning: jet impingement, ultrasonic and megasonic vibration, air-knife drying, warpage during drying, and unnecessary handling.

Features

- Copper-pillar and standard bump flip-chip dipping
- Suited for high-tin alloys
- Ultra-low or near-zero residue levels (ULR/NZR) post-reflow
- Halogen-free (NIA)
- No-clean
- Residues compatible with CUF/MUF



Physical Properties

Properties	Flux Name				Test Method
	NC-699	NC-26-A	NC-26S	NC-809	
Flux Type	REL0	REL0	REL1	REM0	J-STD-004 (IPC-TM-650: 2.3.32 and 2.3.33)
Color	Light yellow	Light tan	Light yellow	Light yellow	Visual
Typical Viscosity and Test Method	1.5kcps Brookfield DV-1. 40CPE Spindle @ 10rpm after 3 minutes	4kcps Brookfield DV-1. 51CPE Spindle @ 10rpm after 5 minutes	13kcps Brookfield DV-1. 51CPE Spindle @ 20rpm after 5 minutes	17kcps Brookfield DV-1. 51CPE Spindle @ 5rpm after 5 minutes	
Typical Acid Value	39mg KOH/g	36mg KOH/g	39mg KOH/g	110mg KOH/g	Titration
SIR Test	Pass	Pass	Pass	Pass	J-STD-004 (IPC-TM-650: 2.6.3.3 IPC-B-24)
Typical Post-Reflow Residue Weight	<2%	~5%	<10%	<7%	TGA data
Working Life	≥ 8 hours	≥ 8 hours	≥ 8 hours	≥ 8 hours	Customer experience (flip-chip)
Shelf Life	12 months when stored at 0–30°C	6 months when stored at 0–30°C	6 months when stored at 0–30°C	6 months when stored at 0–30°C	Viscosity change/ microscopic examination

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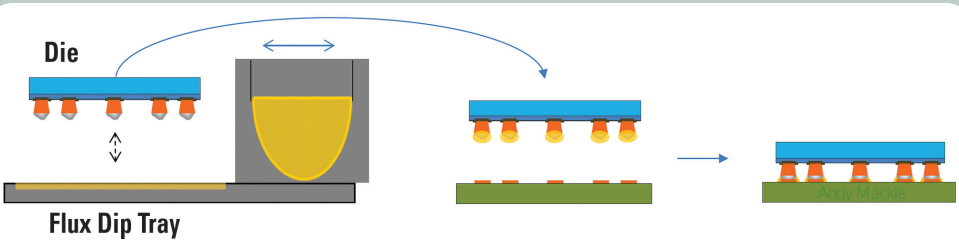
Application

Good | Average | Not Good

	NC-699	NC-26-A	NC-26S	NC-809	Standard No-Clean Flux
Solderability					
Residue level					
Allows easy underfilling with CUF/MUF					
Compatibility with CUF/MUF					
Holds large die in place during reflow					
Use in volume by major OSAT/ODM for thin devices	Memory	Logic	Logic		

Dipping Process

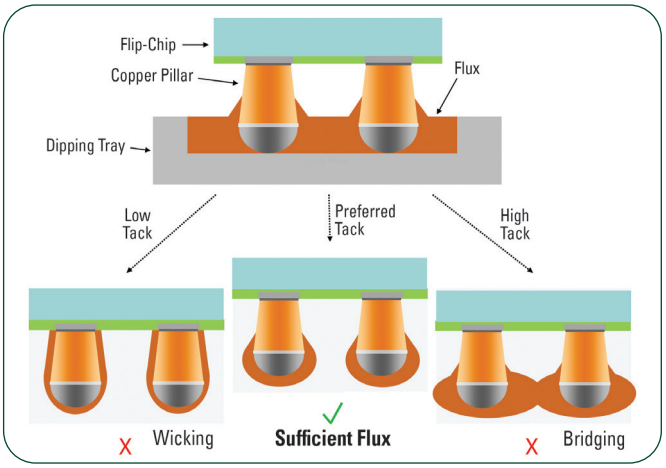
The dipping process is relatively simple, but must be adjusted according to the process needs.

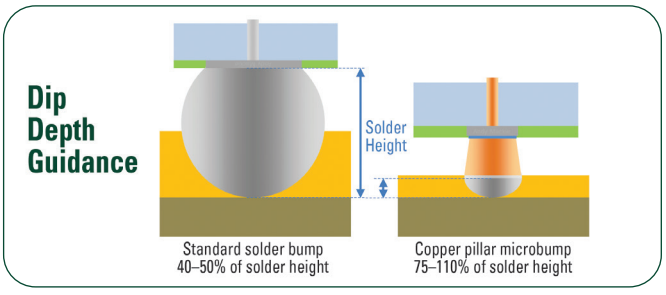


Flux Rheology is Critical

Major Control Variables

- Dipping speed (insertion into dip tray)
  - "Center splash" phenomenon can occur in depopulated areas, as a "wave" of flux touches the bottom of the die
- Dwell time in dip tray
  - Not a major effect except if "wicking" up fine-pitch copper pillars is seen
- Withdrawal speed
  - Affects amount of flux picked up
- Head deceleration after dip
  - Momentum of flux may carry flux up copper pillars if deceleration is sudden after fast withdrawal speed from flux reservoir
- Time of flux in dip tray:
  - Longer time under shear means lower viscosity, until equilibrium viscosity is reached
  - Line stoppage will lead to slow flux viscosity increase
  - Time also affects solvent loss (irreversible "drying")





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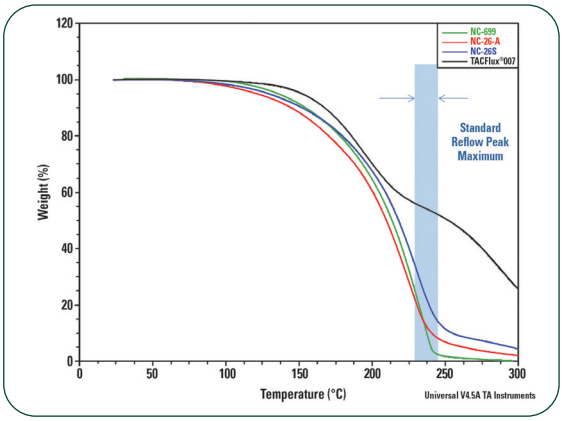


Residue Levels

Thermogravimetric analysis (TGA) allows a small sample of a material to be subjected to controlled heating as the mass of the sample is simultaneously measured.

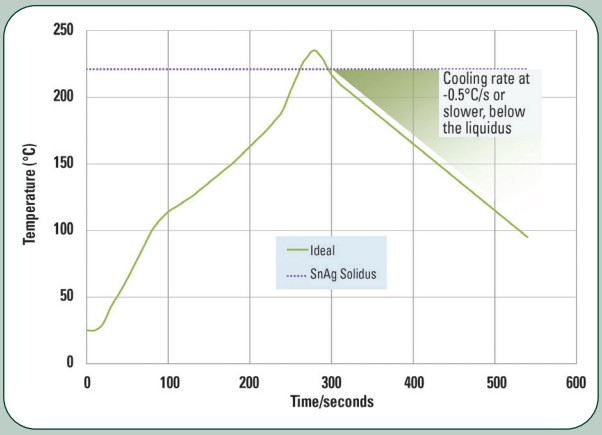
Shown on the left are the TGA curves of the three flip-chip fluxes compared to a standard flux (TACFlux® 007).

Reflow Profile

Indium Corporation **ULR/NZR fluxes** are designed to be reflowed in nitrogen, at an oxygen (O_2) level significantly less than 100ppm O_2. This allows for good solderability onto pads and copper traces.

A standard profile for thinned die and substrates is shown on the right. Oven reflow manufacturers are now designing flip-chip reflow ovens with strong exhausts in the center of the oven (for example, zone 4 of a 7-heated-zone oven), in order to accommodate for the excess flux volatiles that are produced by placing the peak ("spike") heater zone in this location. Slow, controlled cooling allows die and joint damage caused by thinned substrate warpage to be minimized.

The removal of all volatiles from the flux residue is more challenging for larger die, with low clearance (die-substrate distance) and fine-pitch. A reflow profile with a higher peak temperature and a slower cool down rate will allow the volatile materials in these **ULR/NZR fluxes** to be removed more completely.

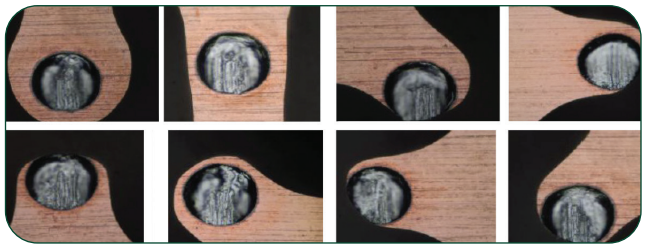


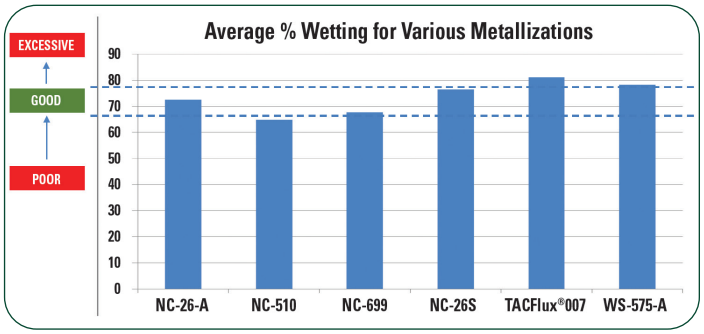
Profile optimized for thin die/thin substrate flip-chip.

Reflow and Solderability (Wetting)

Wetting must be controlled, and balance between:

- **Excessive**: leading to bridging or solder joint starvation
- **Poor**: leading to non-wetting or weak solder joints with voids





Indium Corporation ULR and NZR fluxes allow void-free wetting without bridging.

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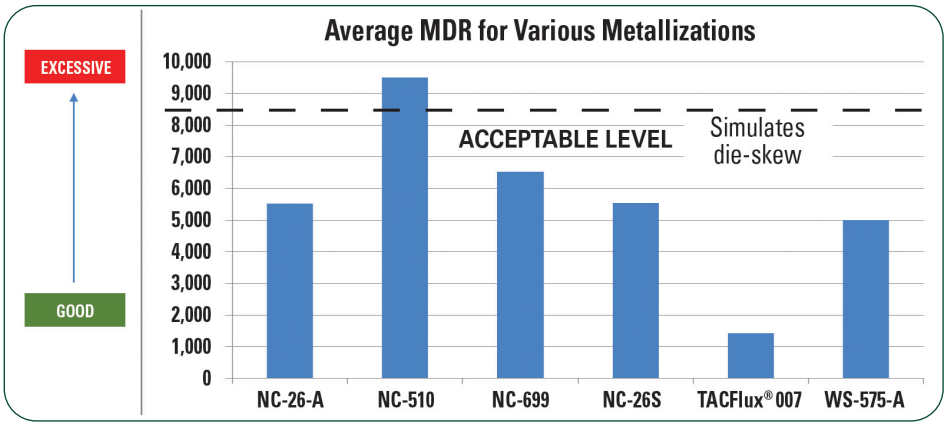
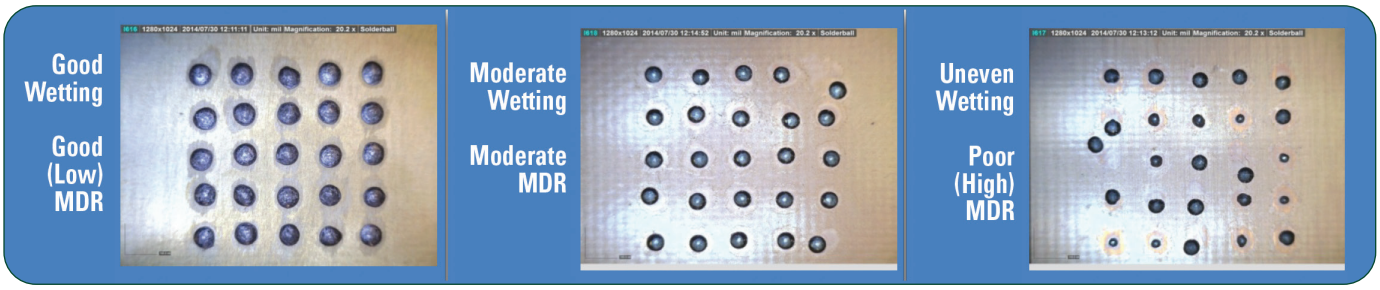
Movement During Reflow

In a standard mass reflow process, the flux must both hold the die in place and also solder quickly, to minimize the die movement during reflow (MDR). MDR results in die misalignment, skew, or die tilt. The MDR test method uses solder spheres precisely mounted in flux; these are then reflowed in place, and the extent of movement away from their centers after reflow.





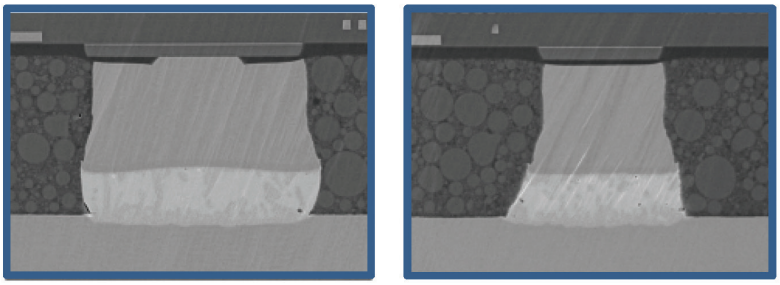
Indium Corporation ULR and NZR fluxes hold die in place during reflow without skewing.

CUF/MUF Compatibility

Delamination at any of the interfaces between the underfill material and the chip can be a source of joint failure during thermal cycling (TC) or thermal shock (TS) testing of the underfilled die. Until now, fluxes have been cleaned away using water or solvent, as they have not been compatible with underfills. Now, with Indium Corporation **ULR and NZR fluxes**, compatibility with uncleaned residues can be achieved. Customer data has proven that even the most demanding molded underfill can be compatible with ULR flux residues after curing and TC.

Compatibility After 1,000 Thermal Cycles (-55/+125°C)

Flip-Chip Flux NC-26-A with Molded Underfill (MUF)



No Delamination

Technical Support

Indium Corporation sets the industry standard in providing rapid response, onsite technical support for our customers worldwide. Indium Corporation's team of Technical Support Engineers can provide expertise in all aspects of Materials Science and Semiconductor Packaging process applications.

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All of Indium Corporation's solder paste and preform manufacturing facilities are IATF 16949:2016 certified.
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ASIA +65 6268 8678 • CHINA +86 (0) 512 628 34900 • EUROPE +44 (0) 1908 580400 • USA +1 315 853 4900

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