

LOCTITE ECCOBOND UF1173

Data Package

November 2018

| Value Message and Proposition

LOCTITE ECCOBOND UF 1173

One Component , Thermal Cure

REACH SVHC Compliant and CMR Free

High T_g

Low CTE

Long Pot Life

High Reliability and SIR performance

- ADAS devices such as Camera and Radar are undergoing package miniaturization to pack more functionality and powerful chips into smaller area. This trend is driving increasing usage of Underfill to maintain high reliability requirements to ensure mechanical strength of solder joints in fine pitch Micro BGA or CSP type packages.
- An underfill that meets rigorous automotive standards (Thermal Reliability and SIR Performance) is also REACH Compliant and CMR Free

| Target ADAS Applications

Key Programs

- **ADAS Camera Vision Sensors** (Stereo Camera , Mono and Surround View cameras)
- **ADAS Radar Sensors** (Mid and Long range Radar systems)
- **ADAS Data Module and LIDAR Sensors**

Key Applications

Cameras

- Stereo, Mono and Surround View

- Blind Spot Detection
- Lane assist
- Traffic sign recognition
- LDS
- PA
- Surround View

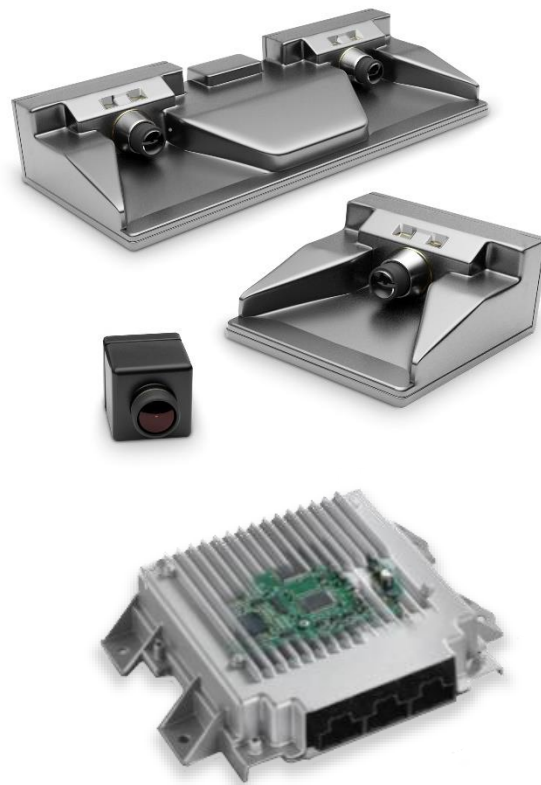
Radar/ LIDAR

- 77GHZ Radar, Solid State Lidar

- Adaptive Cruise
- Emergency Braking
- Collision avoidance
- Cross Traffic Alert

Data Modules

- ADAS Data Module
- ADAS V2X Modules



| Target D&A Applications

Key Programs

- **Aircraft** (planes, helicopters, commercial and military)
 - F-35, F-22, F-16, Eurofighter Typhoon, Apache Helicopter, B-52
- **Maritime systems**
 - Zumwalt, DDG-51
- **UAVs**

Key Applications

Radar & Sonar

- AMDR, EASR, AN/TPY, G/ATOR

- Antennas
- Phase shifters
- T/R modules
- Power modules
- Transmitters
- Sensors

Defense Capability

- Sidewinder, Patriot, Mark 54, Tomahawk, THAAD

- Ballistic missiles
- Cruise missiles
- Guidance systems
- Propulsion systems

Guidance Systems

- Guidance systems
- Navigation systems
- Control Systems
- Satellites



F-35



Boeing Airliner



Airbus Helicopter



DDG-1000 Zumwalt Destroyer



Tomahawk Cruise Missile



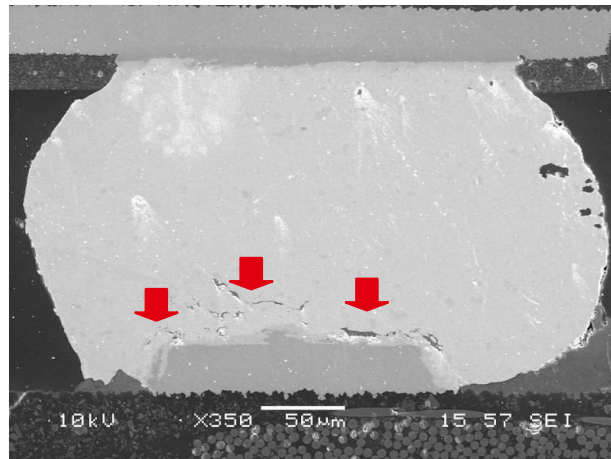
AMDR Radar

| Data Package Review

Introduction

Underfill is mainly used to improve the reliability of a solder joint

- Solder protection
- Thermal reliability
- Drop resistance
- Vibration
- Moisture resistance



| Data Package Review

Benefits & Value Proposition

Current High Reliable Underfills used are:

- Loctite ECCOBOND E1172 A
- Loctite ECCOBOND FP4531

Both products are **CMR** classified; FP4531 is also **SVHC** classified (Candidate List Annex 14).

H341 Suspected of causing genetic defects.



SVHC a substance of **very high concern** is a chemical substance (or part of a group of chemical substances) for which it has been proposed that the use within the European Union be subject to authorization under the REACH Regulation.^[1] Indeed, listing of a substance as a SVHC by the European Chemicals Agency (ECHA) is the first step in the procedure for restriction of use of a chemical.



UF 1173 is developed which has been formulated without any reportable REACH SVHCs (current to June 2018) and is not CMR classified

| Physical Properties

Overview

Item	Test Method	UF 1173
Appearance		Black liquid
Specific gravity	Pycnometer	1.69
Filler loading	by TGA	63 %
Cure profile	DSC	5 min. at 150°C
Viscosity at 25°C 1 s ⁻¹ 10 s ⁻¹	Rheometer, AR1000	5330 mPa.s 7507 mPa.s
Thixotropic Index	1 s ⁻¹ /10 s ⁻¹	0.7
Pot life at 25°C	Rheometer, AR1000, 10 s ⁻¹	> 48 hr. (10% increase at 48 hr.)
DSC Onset Peak Delta H	Dynamic DSC 10dC/min. from 25°C to 250°C	131°C 148°C 215 J/g
T _g by TMA	TMA, 25°C to cure at 10°C/min., cool down to -50°C, test run from -50°C to 250°C at 5°C/min.	160°C
CTE1		26 ppm/°C
CTE2		103 ppm/°C

| Physical Properties

Overview

Item	Test Method	UF 1173
Flexural Modulus at 25°C	DMA, test run from -50°C to 250°C at 5°C/min.	5939 MPa
Ion content Cl- Na+ K+	extractable ion content of cured adhesives using teflon flask at 100°C/24 hr.	18.6 ppm 0 ppm 0 ppm
Moisture absorption	85%RH/ 85°C, 168 hr.	0.93 %
Lap-Shear	Al-Al	8.7 MPa
particle size distribution Maximum Average	Laser particle size analyzer	24 µm 2,9 µm
volume resistivity	High resistance meter	$1.6 \cdot 10^{15} \Omega \cdot m$
dielectric constant Dissipation Factor	High Q meter	3.4 (at 2MHz) 0,0023
Thermal conductivity	Laser flash	0.55 W/(m.K)

Physical Properties

DSC – Cure Profile

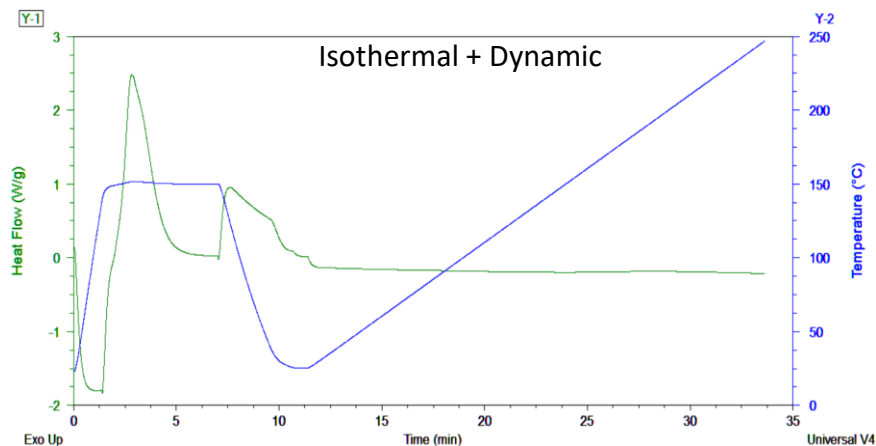
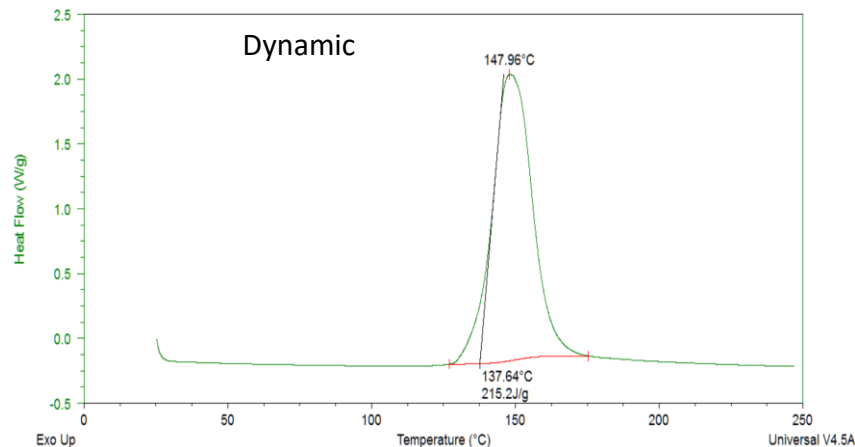
Test method:

Dynamic and Isothermal

Test parameter

- Dynamic: 25°C to 250°C at 10°C/min.
- Isothermal: jump to 150°C and keep for 5 min.; cool down to RT followed by a Dynamic DSC.

⇒ No Rest-peak seen during the Dynamic DSC indicating cure is complete after 5 min. at 150°C



Physical Properties

TMA

Test method:

TMA

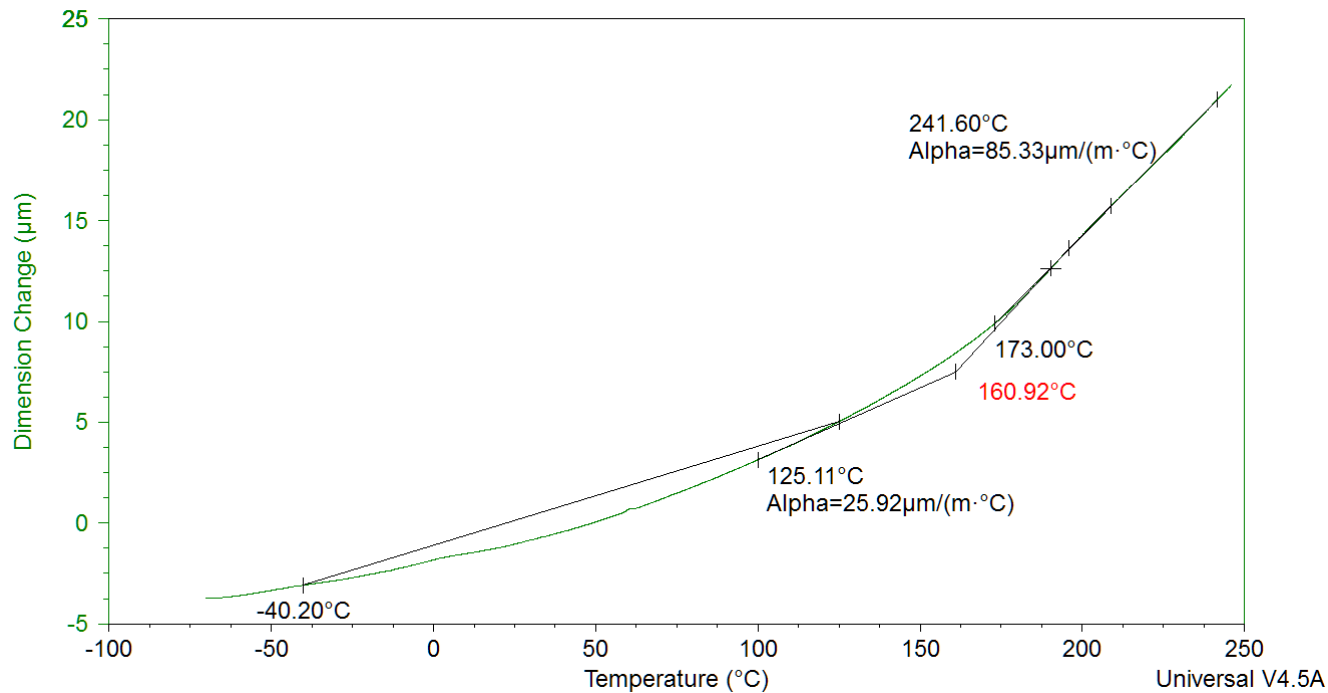
Test parameters

Sample size:

height: 4.5 mm

diameter: 3.5 mm

Profile: -70°C to 250°C at 10°C/m



| Physical Properties

DMA

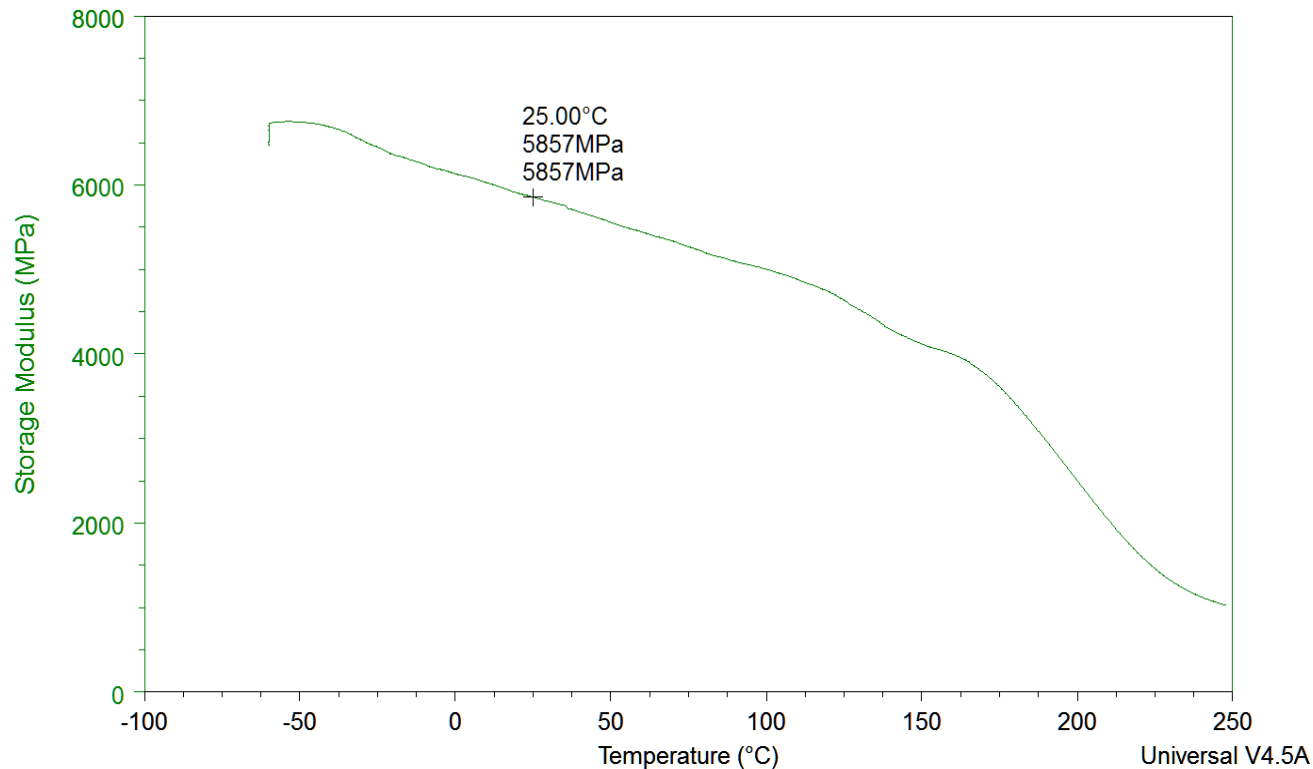
Test method:

DMA

Test parameter:

Sample size:

17,5mm*10,5mm*5,08mm
-50°C to 250°C at 5°C/min,
frequency 10HZ



Physical Properties

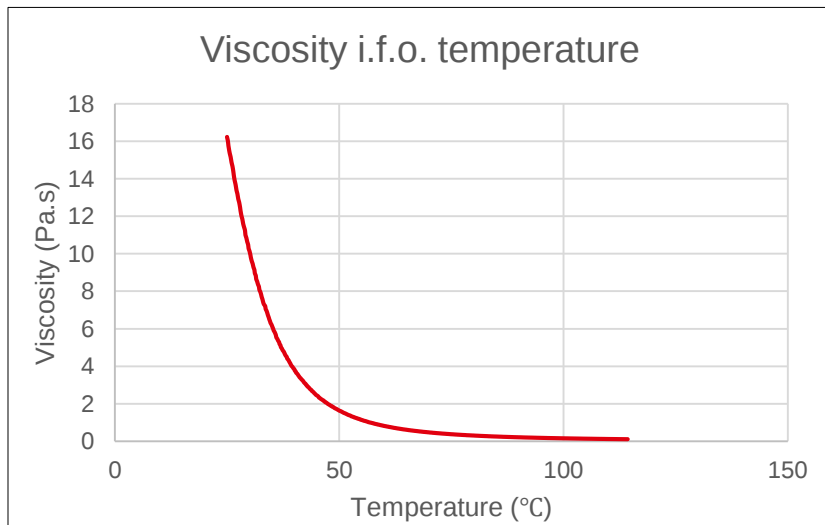
Viscosity

Test method:

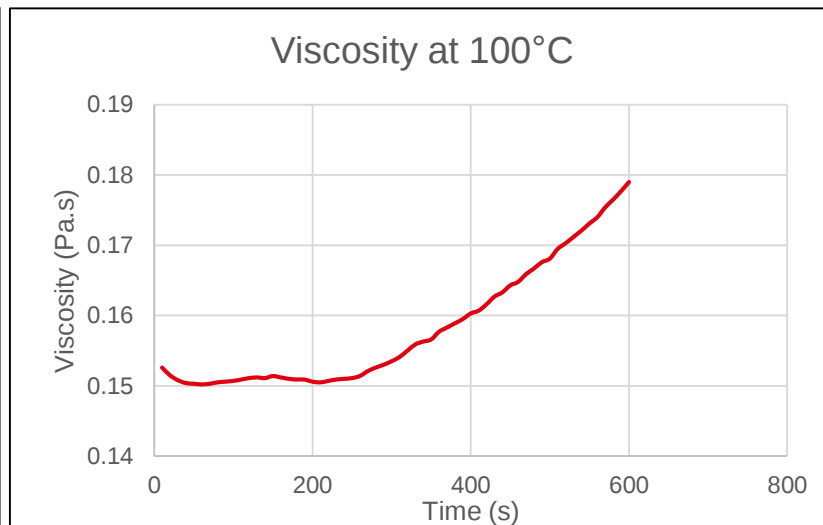
Dynamic and Isothermal

Test parameter

- Dynamic: ramp to 150 °C, stop when the viscosity increases rapidly
- Isothermal: ramp to 100°C and keep for 10 min.



Dynamic



Isothermal

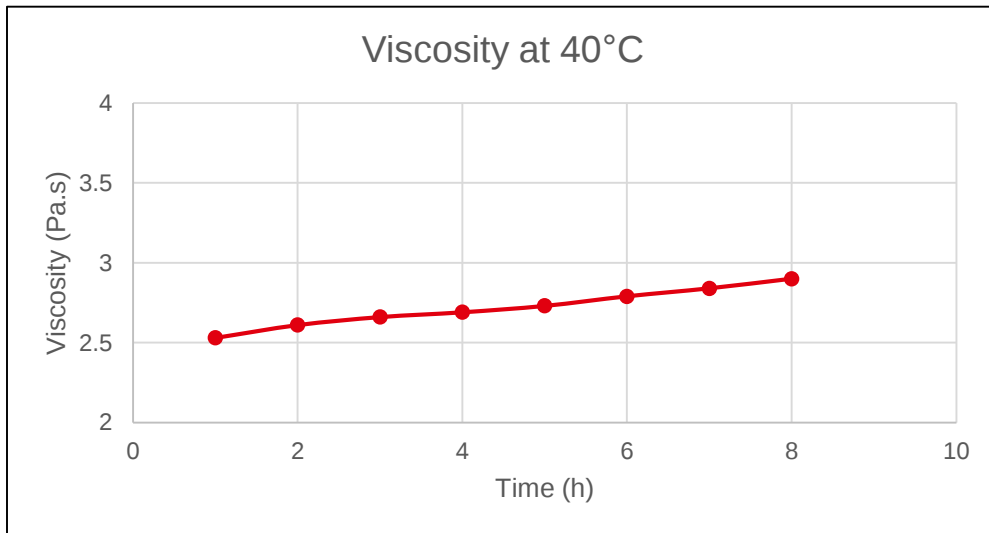
| Physical Properties

Viscosity

Test method:

Rheometer 20 mm plate - plate 200 μ gap

Test at 40°C for 8 hr. and test every hour



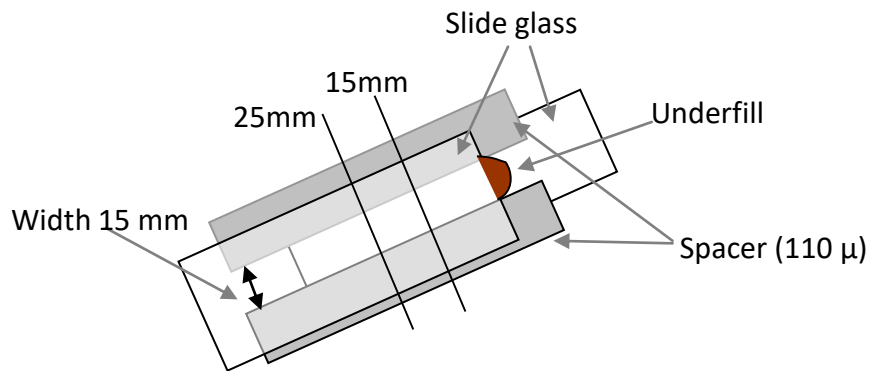
⇒ **Very stable viscosity, even at elevated temperatures**

| Performance

Flow Rate

Test method:

- Substrate: glass slide
- Spacer thickness: 110 μ
- Test T: 90°C
- Record the time underfill flow 1.5 and 2.5cm under different gap size
- Compared to E1172A and FP4531 (standard high reliable UF materials)



Test results:

Flow time	15 mm	25 mm
UF 1173	17 s	43 s
E1172A	26 s	67 s
FP4531	30 s	80 s



| Process Guidelines

Application parameters – Jet dispensing

■ Underfill:

- UF 1173

■ Jetting Parameters on Asymtek S920

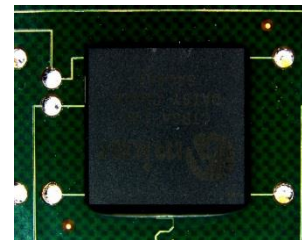
with DJ9000 valve:

- Fluid Pressure 10 psi
- Valve pressure 90 psi
- Needle: 3.2 mm
- Nozzle: 250 μ ; seat 750 μ
- Nozzle temperature: 60°C
- Substrate temperature: 90°C
- Dispense Pattern: i-shape (line on the bottom side)

⇒ Very stable dot formation during 6 hours of jetting

■ Observations:

- Dummy component (12x12 mm) got underfilled in less than 40 seconds.
- i-shape (bottom side of the picture)
- 12 mg per pass
- 3 passes with waiting times in between of 6 seconds after pass 1 and 15 seconds after pass 2.
- Very even and fast flow under the component (gap 200 μ)
- Nice fillet formation on the opposite sides.



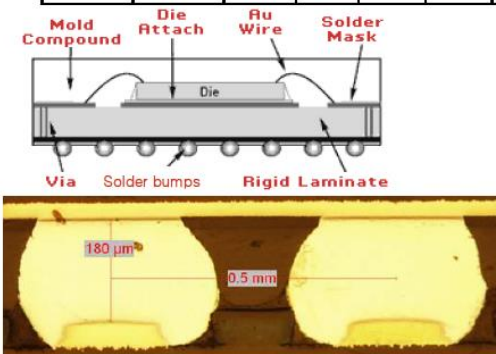
Performance

Thermal Cycling Performance

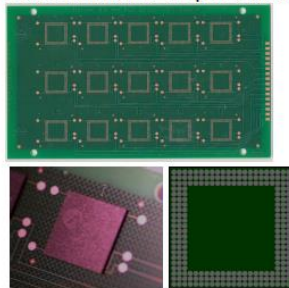
Test Vehicle:

Package details

Package	Solder bumps	I/O Count	Pitch (mm)	Size (mm)	Array	Array Config	Solderball dim.	
							Height (mm)	Diameter (mm)
CTBGA-228	SAC	228	0.5	12	22 x 22	Perimeter	0.18	0.32



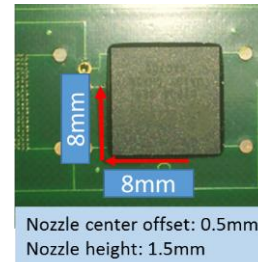
Jedec standard drop test board



Board thickness: 2 mm

Sample Preparation:

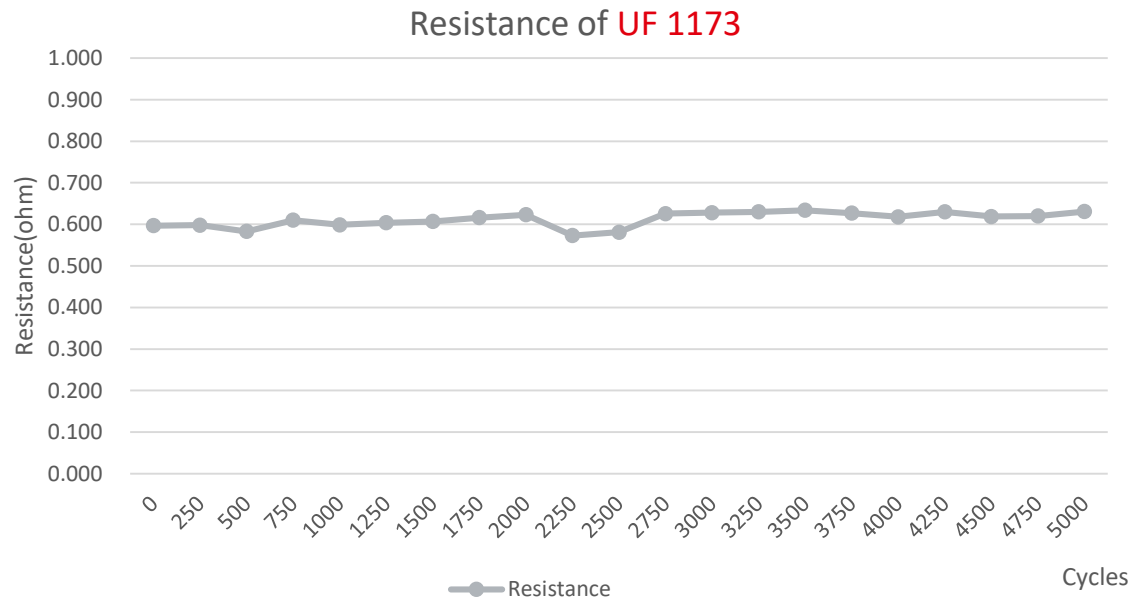
- Sample ID: UF 1173
- Quantity: 5 pcs
- Jetting Nozzle: 0.15 mm
 - Nozzle Heat: 40°C
- Substrate Preheat: 80°C
- Time: 3 min.
- L-shape: 4*11mg
- Result: Good



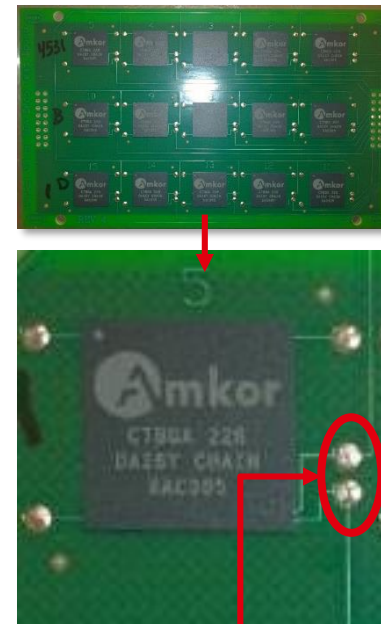
Performance

Thermal Cycling Performance

-40°C => +150°C / Thermal Shock / 30 min dwell



- ⇒ Passed 5000 cycles Thermal shock of -40/150°C
- ⇒ Without UF, this assembly fails @ +/- 500 cycles



Probing points

Thank you!