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Data Sheet
8080LP2

Preliminary

R/flex® 8080LP2
Liquid Photoimageable Covercoat

Introduction

With recent increases in the demand and requirements for high-density circuitry and high-density multilayer circuitry in printed-circuit boards, fine-pattern circuit technology is now required for flexible printed-circuit boards.

R/flex® 8080 Liquid Photoimageable Covercoat, an alkaline-developable solder resist ink, responds to the requirements of high reliability and mass production characteristics for high-density flexible printed-circuit boards now required by the industry.

Features

(1) R/flex 8080LP2 is an alkaline-developable liquid photoimageable solder mask developed for flexible circuit boards. This product can achieve fine patterns not attainable by conventional screen printing.

(2) Since this is a liquid mask that is contact-photoexposed, it can form a high-precision mask pattern as an insulation and solder resist for Flexible Printed Circuits (FPCs) that are required to have fine, high-density patterns.

(3) R/flex 8080LP2 has a long shelf life/pot life and excellent stability in processing operations.

(4) R/flex 8080LP2 has excellent adhesion, heat resistance and electrical insulation properties.

(5) R/flex 8080LP2 also exhibits excellent plating resistance to all plating chemistries including electroless Ni and Au plating.

Ink Specifications

Property		Typical Values	Remarks
color and state	base	green paste	
	hardener	white paste	
mixing ratio		base 100g/hardner 46g	
nonvolatile component		73 weight %	1 hr/130°C (266°F) in an oven
specific gravity	base	1.2	specific gravity cup method
	hardener	1.2	at 25°C (77°F)
viscosity		200 to 240 ps	Viscotester-VT-04 (25°C/77°F)
thixotropy index		1.7 to 2.2	brookfield HBT (n5/n50)
shelf life		6 months 3 months	storage at 5°C (41°F) storage at 25°C (77°F)
pot life		about 3 days	after addition of hardener (25LC/77F)

Directions for Use

(1) Mixing the hardener: Mix at a ratio of 1 part resin to 0.46 parts hardener. Mix thoroughly. Allow mixture to stand at least 30 minutes after mixing for the viscosity to stabilize.

(2) Screen printing: A 100 to 150 mesh polyester screen is recommended. The optimal post-drying coating thickness over conductors is 15 to 20µm (0.0006" to 0.0008").

Note: Dilution: Dilution causes thinning at the edges of the circuit pattern and therefore should be avoided as much as possible. (When dilution is unavoidable, use a solvent consisting of Carbitol Acetate and Petroleum Naptha in a 2:1 ratio).

(3) Drying:

Standard conditions

a) For simultaneous photoexposure of both sides (convection oven)
first side: 75°C (167°F), 20 minutes
or
80°C (176°F), 15 minutes
second side: 75°C (167°F), 30 minutes
or
80°C (176°F), 25 minutes

b) For photoexposure of a single side (convection oven)
75°C (167°F), 30 minutes
or
80°C (176°F), 25 minutes

Note. Standard conditions are described for a post-drying film thickness of 15 to 20µm (0.0006" to 0.0008") over the conductors; however, one should be aware that the drying efficiency varies significantly as a function of the conductor thickness and conductor density as this impacts overall film thickness.

The maximum allowable drying conditions are 75 minutes at 75°C (167°F) or 60 minutes at 80°C (176°F). Conditions more severe than this cause poor strippability during development.

(4) Cooling: The board should be cooled to room temperature before photoexposure.

(5) Photoexposure: Standard conditions 500 mJ/cm^2 (effective value through polyester film or glass).

The optimal exposure device will use a 7 kW metal halide lamp. While an ultrahigh-pressure mercury lamp can be used, the use of such a lamp may require stronger exposure.

(6) Development: Development should be carried out using a 1.0 to 1.5 weight % aqueous solution of sodium carbonate (Na_2CO_3) at a solution temperature of at least 30°C (86°F) using a spray pressure of 1.5 to 2.5 kg/cm^2 for at least 60 seconds followed by a water rinse for at least 60 seconds.

standard conditions
developing solution: 1 wt % aqueous Na_2CO_3 solution
solution temperature: 30°C (86°F)
spray pressure: 2 kg/cm^2
developing time: 60 seconds
water rinse duration: 60 seconds

(7) Final cure: Curing should be carried out in a convection oven at 150 to 160°C (302 to 320°F) for at least 30 minutes.

standard conditions
150°C (302°F), 30 minutes

Note: When flexibility is a particularly important issue:

1. Avoid unnecessary exposure to UV
2. Avoid long curing times (total not to exceed 60 minutes)

Remarks

Flexible circuit handling

- The coating is fragile until it is thermallly cured. Care should be exercised in handling until the completion of final cure.

Board rework

- After printing: Remove with developing solution after drying.
- After drying: Remove with developing solution.
- After exposure or developing: Strippable by dipping in 5% NaOH, 50 to 60°C (122 to 140°F), for at least 5 minutes. However, the stripping conditions can vary as a function of the film thickness, exposure dose, etc.

Note: Since alkali will remain on the board after removal, the board should be subjected to another pretreatment (acid treatment, scrubbing).

Operating conditions

- Always work in a clean room under yellow illumination
- Temperature = 22 to 26°C (72 to 79°F)
- Humidity = 50 to 60%

Transporting

- For D.O.T. purposes this material falls under Hazardous Material Class 3 flammable liquid and should be handled in conformity with the corresponding laws and regulations.

Storage

- A designated area should be established and the product should be stored in a cool, dark place with good ventilation and without exposure to direct sunlight. The recommended storage temperature is 5 to 25°C (41 to 77°F).

- If stored at low temperature, the product temperature must be raised to room temperature before opening to prevent moisture condensation on the product. It is recommended the product be conditioned at room temperature for 24 hours before opening.

- A ventilator should be installed and the working area should be well ventilated. A local ventilator is required since the product contains an organic solvent.

- Protective clothing such as gloves and an apron should be worn when handling the product in order to avoid contact with the skin. In the event of contact with the skin, wash with soapy water.

- Wash hands and face after handling.

Pot Life (Developability and Change in Viscosity after Hardener Addition)

abbrevations used in the table: CD = complete development - ID = incomplete development

	Initially after mixing	1 day	2 days	3 days	4 days	5 days
viscosity (25°C/77°F)	210 ps	230 ps	240 ps	240 ps	240 ps	250 ps
*developability drying conditions						
80°C/176°F/30 minutes	CD	CD	CD	CD	CD	CD
80°C/176°F/40 minutes	CD	CD	CD	CD	CD	CD
80°C/176°F/50 minutes	CD	CD	CD	CD	CD	CD
80°C/176°F/60 minutes	CD	CD	CD	CD	CD	CD
80°C/176°F/70 minutes	CD	CD	CD	CD	CD	ID
80°C/176°F/80 minutes	CD	CD	CD	ID	ID	ID
80°C/176°F/90 minutes	ID	ID	ID	ID	ID	ID

Note: Standing at 25°C (77°F) after mixing.
The developability declines with elapsed time after mixing as reported above. Although use is possible up to 5 days for drying conditions of 80°C/176°F/60 minutes, a pot life of 2 days is specified in order to provide a safety factor.

Developability: Screen printed to thickness of approximately 15µm (0.0006") after drying. Developed with 1% aqueous sodium carbonate solutions at 30°C (86°F) for one minute.

*Drying Temperature and Developability

abbreviations used in the table: CD = complete development — ID = Incomplete development

Temperature	75°C /167°F	80°C / 176°F	85°C / 185°F	90°C / 195°F
drying time				
30 minutes	CD	CD	CD	CD
40 minutes	CD	CD	CD	ID
50 minutes	CD	CD	CD	ID
60 minutes	CD	CD	ID	ID
70 minutes	CD	CD	ID	ID
80 minutes	CD	CD	ID	ID
90 minutes	CD	ID	ID	ID

*Screen printed to a thickness of approximately 15µm (0.0006") after drying. Developed with 1% aqueous sodium carbonate solution at 30°C (86°F) for one minute.

*Post-Coating Developability

abbreviations used in the table: CD = complete development — ID = Incomplete development

	immediately after coating and drying	1 day	2 days	3 days
drying conditions				
80°C/176°F/30 minutes	CD	CD	CD	CD
80°C/176°F/40 minutes	CD	CD	CD	CD
80°C/176°F/50 minutes	CD	CD	CD	CD
80°C/176°F/60 minutes	CD	CD	CD	CD
80°C/176°F/70 minutes	CD	CD	CD	ID
80°C/176°F/80 minutes	CD	CD	CD	ID
80°C/176°F/90 minutes	ID	ID	ID	ID

After tack-drying the coated product can be stored in a cool, dark environment for several days prior to developing. The storage time possible is a function of the drying conditions. Screen printed to a thickness of approximately 15mm (0.0006") after drying. Developed with 1% aqueous sodium carbonate solution at 30°C (86°F) for one minute.

1-1 Physical Properties of the Film

Property	Typical Value	Measurement Method
surface hardness (on Cu)	5H	JIS K 5400 or ASTM equiv.
adherence (on Cu)	100/100	JIS D 0202 or ASTM equiv.
soldering heat resistance (on Cu)	pass: 5 sec. x 2 cycles	260°C / 500°F (rosin-based flux)
flex resistance	500 cycles	MIT tester/0.35mm dia.
boiling test	1 hour, no abnormalities	
solvent resistance		
chlorothene	30 min dipping: no abnormalities	dipping at 25°C (77°F)
Triclene	30 min dipping: no abnormalities	dipping at 25°C (77°F)
IPA	30 min dipping: no abnormalities	dipping at 25°C (77°F)
meghylene chloride	10 min dipping: no abnormalities	dipping at 25°C (77°F)
chemical resistance		
$1H_2SO_4$	30 min dipping: no abnormalities	dipping at 25°C (77°F)
10% HCl	30 min dipping: no abnormalities	dipping at 25°C (77°F)
5% NAOH	30 min dipping: no abnormalities	dipping at 25°C (77°F)
Flammability	94V-0 (on 94V-0 substrates	UL 94

1-2 Physical Properties of the Film: Plating Resistance

Type of Plating	Conditions	Results	Manufacturer	Product Name
electrolytic Ni	15 A/dm^2, 50°C(122°F), 15 min	no abnormalities	Nippon Schering	
electrolytic Au	0.8 A/dm^2, 50°C(122°F), 8 min	no abnormalities	Nippon Schering	
electroless Sn	70°C (158°F), pH = 0.9, 5 min	no abnormalities	Uemura Kogyo	Beamstarner ELT812
electroless Ni	85°C (185°F), pH = 5.1, 15 min	no abnormalities	Okuno Seiyaku	ICP Nikolon
electroless Au	90°C (194°F), pH = 5.8, 15 min	no abnormalities	Okuno Seiyaku	OPC MudenGold

Conditions for test board fabrication:

IPC-B-25 test boards were used; 80°C(176°F)/25 min drying — 500 mJ/cm^2 exposure — 30°C(86°F)/1 min. development — 150°C(302°F) /30 min. curing.

1-3 Physical Properties of the Film

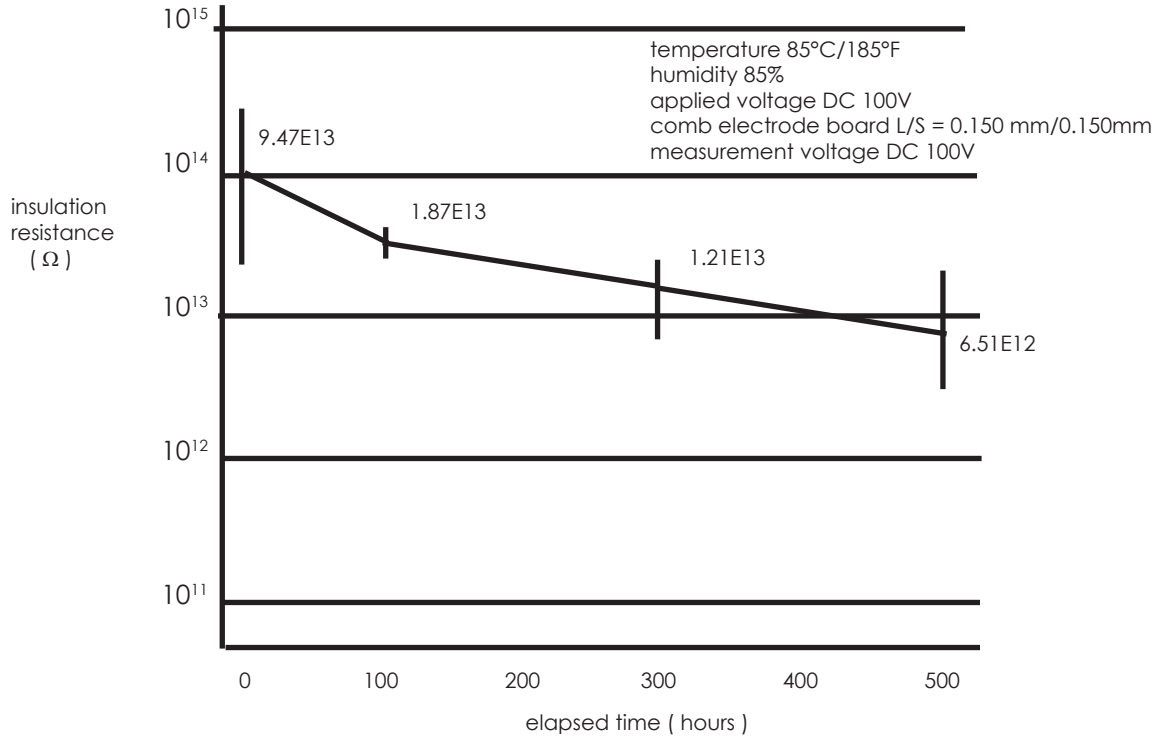
Property	Characteristic Value	Measurement Method
glass-transition temperature	90°C (194°F)	thermal analysis (TMA)
thermal decomposition	338°C (640°F)	thermal analysis (TGA) 5% wt loss
specific gravity of coating (23°C/73°F)	1.37	JIS K 7112, method C or ASTM equiv. (flotation method)
Water absorption water immersion, 24 hr/23°C/73°F 4 hr/85%/85°C/185°F	 1.29% 0.73%	 JIS K 6911 (film thickness - 60 mm) or ASTM equiv.

2 Properties of the Film according to IPC-SM-840

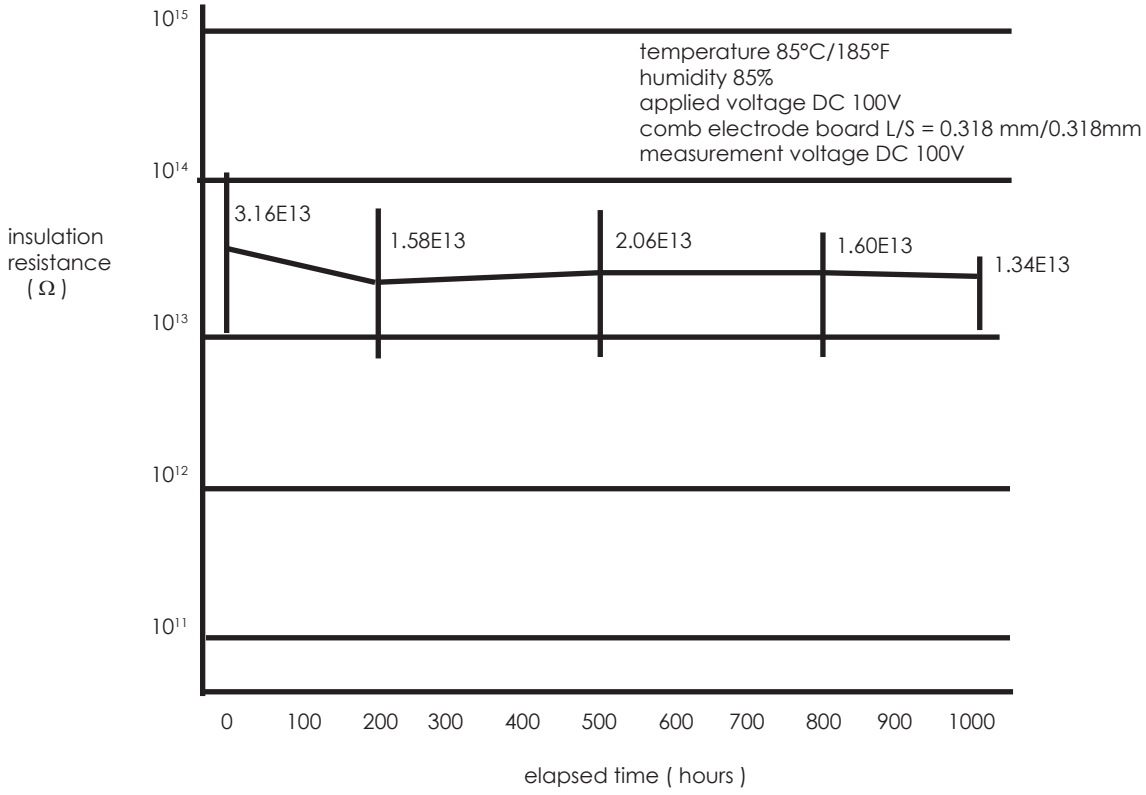
Item No.	Item	Test Method	Requirements	Test Results
3.4.7	appearance	visual evaluation using a 1.75X - 10X magnifying glass	absence of foreign material, cracks, peeling, roughness	satisfies requirements
3.5.2.1	adherence	tape peel method	Cu ≥ 0% Ni/Au ≥ 5% board ≥ 0% solder, etc. ≥ 10%	satisfies requirements
3.5.3	cutting machinability	no abnormalities when processed using conventional processing equipment	no blistering or peeling	satisfies requirements
3.5.1.2	abrasion resistance	pencil method	no scratching with a pencil softer than F	satisfies requirements
3.4.4	cure	3.6.1 Solvent resistance and flux resistance 3.7.1 Solderability and solder resistance 3.7.2 Soldering and desoldering test	satisfies the requirements of 3.6.1, 3.7.1, 3.7.2	satisfies requirements
3.6.1	solvent resistance cleaner resistance flux resistance	IPA, 1,1,1-trichloroethane room temperature 4% ethanol + 96% trichlorotrifluoroethane vapor-phase degreasing boiling 10% alkaline cleaner 57 ± 2°C (135 ± 36°F) 40% alkanolamine 20% 2-butoxyethanol 29% glycol ether + water 90% pH - 13	dry for 10 minutes at ambient temperature after dipping for 2 minutes; no blistering, peeling, or discoloration	satisfies requirements
3.6.3	flammability	UL standard	the UL94 V number of the board should not be increased by more than 1	UL94 V-0
3.7.1	solderability	after flux application, standing for 5 minutes at ambient temperature, and preheat, 260 ± 5°C (500 ± 9°F) /10 sec. floation	uncoated metal regions are perfectly soldered	satisfies requirements
3.7.2	solder resistance	after flux application, standing for 5 minutes at ambient temperature, and preheat, 260 ± 5°C(500 ± 9°F) /10 sec. floation	no abnormalities in the solder mask using the appearance evaluation of 3.4.7	satisfies requirements
3.7.3	solder attachment and stripping	2 cycles of solder attachment with a soldering iron and stripping 2 to 3 seconds	the solder mask does not peel from the substrate or conductors	satisfies requirements
3.6.2	hydrolic stability aging stability	Class 1, 35°C (95°F) /90%RH/4 days Class 2, 85°C (185°F) /90%RH/7 days Class 3, 97°C (207°F) 90%RH/28 days	no degradation	meets Class 1 meets Class 2 meets Class 3
3.8.1	dielectric strength	electrode (2 inch diameter, 1/4 inch radius) 500V/sec. voltage rise	≥ 500 V/mil	700 V/mil
3.8.2	insulation resistance	pattern B or pattern E, both before and after soldering	$\geq 5 \times 10^8 \Omega$	meets Class 3 $2.5 \times 10^{12} \Omega$
3.9.1	humidity insulation resistance	Class 3; 25 to 65°C (77 to 149°F) 90%RH, applied voltage = DC 100V, 7 days pattern B or pattern E	$\geq 5 \times 10^8 \Omega$	meets Class 3 $1.8 \times 10^{12} \Omega$
3.9.2	electromigration	85 ± 2°C (185 ± 4°F) / 90%RH, applied voltage = DC 10V, 7 days pattern B or pattern E	no electromigration	meets requirements

The values reported above are based on experimental results and are not guaranteed.

Electrical Insulation Characteristics — 1

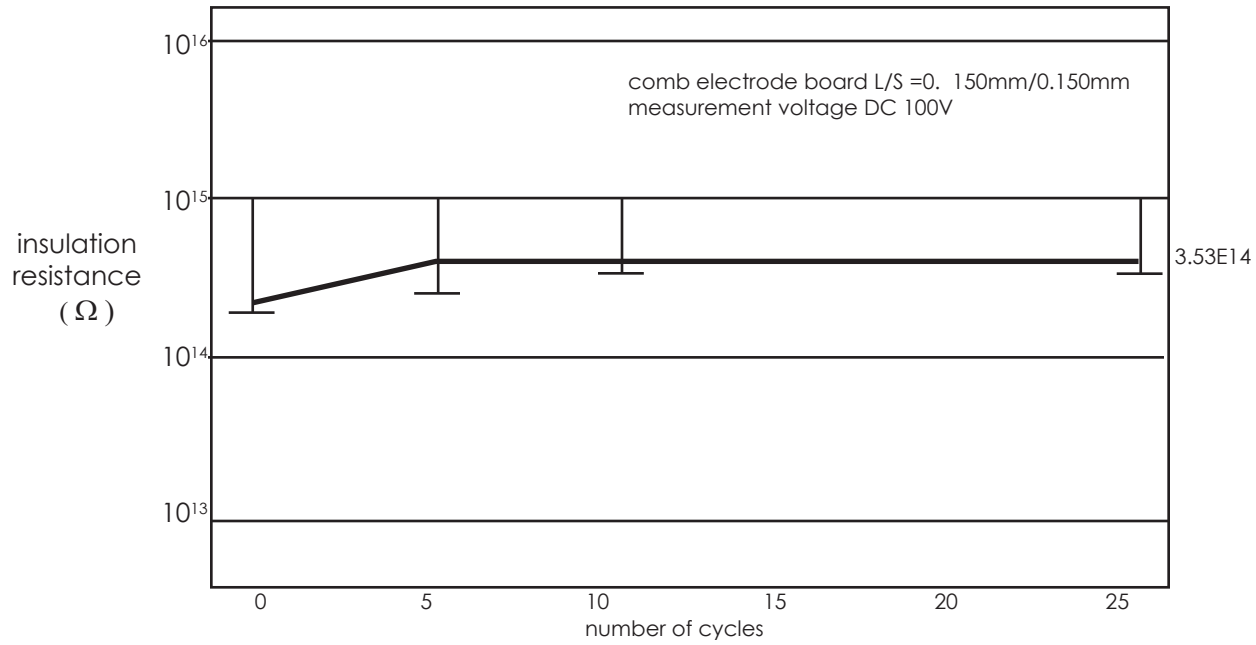


Electrical Insulation Characteristics — 2



Thermal Cycle Testing -50°C (-58°F) x +85°C (+185°F)

Electrical Insulation characteristics



Film Properties After Thermal Cycle Tests

Property	Number of Cycles				
	0	5	15	25	Remarks
Film appearance	—	no abnormalities	no abnormalities	no abnormalities	visual inspection
hardness (on Cu)	5H	5H	5H	5H	*JIS K 5400
adherence (on Cu)	10 points	10 points	10 points	10 points	*JIS K 5400
adherence (on Kapton 100H)	10 points	10 points	10 points	10 points	*JIS K 5400
solder heat resistance	passes	passes	passes	passes	260°C/500°F, 5 sec x 2 times
flexiblility (on Kapton 100H)	no cracking	no cracking	no cracking	no cracking	1 time at 180° bend

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