TAMURA
PRODUCT INFORMATION

FINEDEL DSR-2200TL 05M

FINEDEL DSR-2200TL 05M is an alkali developing type, photo-imageable liquid solder resist for simultaneous exposure on both sides of printed wiring board. This solder resist is superior to previous one in terms of resolution and resistance to gold plating. This product shows green and mat surface.

1. General specifications for FINEDEL DSR-2200TL 05M

Table 1 General specifications of DSR-2200TL 05M

Items	Specification
Color	GREEN
Viscosity	220 dPa・s (Brookfield HBT at 25℃)
Specific gravity	1.3
Non-volatile components	78 %
Flash point (Tag closed type)	76℃
Mixing ratio	Main component : 750 g Hardening agent : 250 g
Pot life (When stored in a dark place at below 20℃)	24 hours after mixing hardening agent
Shelf life (When stored in a dark place at below 20℃)	Main component and hardening agent: 3 months

2. Example of board processing

Surface treatment of boards	Acid treatment and polishing
↓	
Application to solder side	Screen printing (Screen: T-100B, Emulsion thickness: 12 μm) Wet thickness of coating: 35-40 μm
↓	
Pre-drying	75℃ 20 minutes
↓	
Application to component side	Screen printing (Screen: T-100B, emulsion: 12 μm) Wet thickness of coating: 35-40 μm
↓	
Pre-drying	75℃ 30 minutes
↓	
Exposure	300-400 mJ/cm^2 (On the resist surface)
↓	
Developing	1 % sodium carbonate, 28-30℃, 60 seconds 0.2 MPa spray pressure
↓	
Post cure	150℃ 60 minutes
↓	
UV curing*	1000 mJ/cm^2 (80 W/cm, 3 lamps, 5 m/min)

* Perform UV curing process when it is desired to improve the resistance to Au-plating, or when using high activity flux in soldering process of hot air leveler.

3. Experiment data (Reference)

3-1. Properties of cured film of FINEDEL DSR-2200TL 05M

Table 2 Hardened film performance of FINEDEL DSR-2200TL 05M

Items	Performance	Test methods (Test conditions)
1.Pencil Hardness	6H	IPC-SM-840C 3.5.1/TM 2.4.27.2
2. Adhesion	Passed	IPC-SM-840C 3.5.2.1/TM 2.4.28.1 No peeling shall occur on copper or boards.
3. Machinability	Passed	IPC-SM-840C 3.5.3 No crack or burst greater than those observed on the base material shall be caused on the film when drilling, sawing and press punching is performed.
4. Resistance to solvents and cleaning agents	Passed	IPC-SM-840C 3.6.1.1 No blister, peeling, swelling or discoloration shall occur on the film: Isopropanol Room temperature 2 minutes 75 % Isopropanol/25 % water 46±2℃ 15 minutes D-limonene Room temperature 2 minutes 10 % alkaline detergent 57±2℃ 2 minutes Monoethanolamine 57±2℃ 2 minutes Ion exchanged water 60±2℃ 5 minutes
	No abnormality on the film	No abnormality shall occur on the film. 10 % hydrochloric acid Room temperature 30 minutes 10 % sulfuric acid Room temperature 30 minutes 10 % sodium hydroxide Room temperature 60 minutes
5. Adhesion immediately after boiling	No abnormality on the film	100℃ 5 hours, Observe the appearance after tape peeling.
6. Adhesion after treatment with pressure cooker	No abnormality on the film	121℃ 0.2 MPa 5 hours, Observe the appearance after tape peeling.
7-1. Solderability	Passed	IPC-SM-840C 3.7 Solderability 3.7.1 No bad influence shall be caused on the solderability of the spot to be soldered when soldering is performed in accordance with J-STD-003.
7-2. Resistance to solder	Passed	IPC-SM-840C 3.7 Resistance to soldering 3.7.2 No solder shall adhere to the film after soldering (260±5℃, 10±1 seconds.) under the specified conditions (J-STD-004: M type flux, J-STD-006; Sn60 or Sn63 solder).
8. Solder heat resistance *1	No abnormality on the film	No blister or peeling shall occur on the film. Observe the appearance after tape peeling Flux: SOLDERITE MH-820V Solder temperature 260℃, 10 seconds, dipping 3 times

Items	Performance	Test methods (Test conditions)
9. Resistance to hot air leveler	No abnormality on the film	No blister or peeling shall occur on the film. Observe the appearance after tape peeling. Flux: SOLDERITE HL-201A, solder temperature 240 ℃, dipping time 4 seconds, hot air temperature 220℃, pressure 0.38 MPa, dipping 3 times
10. Dielectric strength	40 DC V/μm (1000 DC V/mil)	IPC-SM-840C 3.8.1/TM2.5.6.1 20 DC V/μm or over (500 DC V/mil or over)
11. Volume resistivity	1×10^{15} Ωcm	IPC-TM-650 2.5.17.1
12. Surface resistance	1×10^{15} Ω	IPC-TM-650 2.5.17.1
13. Insulation resistance	Before soldering 1×10^{14} Ω After soldering 1×10^{14} Ω	IPC-SM-840C 3.8.2/TM 2.6.3.1 (IPC B pattern) More than 500 MΩ for before and after soldering.
14. Moisture and insulation resistance	1×10^{9} Ω (In-humidity) 1×10^{11}Ω (Outside the tank)	IPC-SM-840C 3.9.1/TM 2.6.3.1 Class H 65℃ 85%RH 6+2/3 days (Bias voltage; 50 V and test voltage; 100 V) More than 100 MΩ
15. Electrochemical migration	No occurrence 1×10^{13}Ω	IPC-SM-840C 3.9.2/TM 2.6.14 Class H 85℃ 90%RH 168 h (Bias voltage; 10 V and test voltage; 10 V) No occurrence of migration and the insulation resistance shall be higher than 2 MΩ
16. Thermal shock	No abnormality on the film	IPC-SM-840C 3.9.3/TM 2.6.7.1 Class H -65-125℃ 100 cycles No blister, crack nor peeling of the film.
17. Dielectric loss tangent (tanδ)	0.03	IPC-TM-650 2.5.5.4 Impedance analyzer (4192A LF manufactured by Yokogawa Hewlett Packard was used) 1 MHz
18. Permittivity (ε)	3.5	IPC-TM-650 2.5.5.4 1 MHz
19. Sensitivity	Step 11	350 mJ/cm^2 (above the resist surface), Kodak step tablets 21 step
20. Resolution	60 μm	UV light energy: 350 mJ/cm^2 on surface of pre-dried resist. Coating thickness: 35 μm (wet) Test boards: For QFP mounting use, with 50 μm of copper.
21. Resistance to gold plating*2	No abnormality in cured film No abnormality in cured film	No blistering, peeling, swelling or discoloration shall occur on the film. 1) Electrolytic gold plating 42℃, 1.0 A/dm^2, 5 minutes, appearance after peeling off tape. 2) Non-electrolytic gold plating 90℃, 5 minutes, appearance after peeling off tape.

*1 Abnormality may occur on the film, depending on the type of flux used. Use, therefore, after performing tests in advance.

*2 Abnormality may occur on the film, depending on conditions of plating bath. Use, therefore, after performing tests in advance.

Items	Performance	Test methods (Test conditions)
22. Ionizable detection of surface contaminants (Dynamic method)	0.32 μgNaCl/cm^2 (2.0 μgNaCl/$Inch^2$)	IPC-TM-650 2.3.26 (MIL-P-28809 and MIL-P-55110)
23. Solder ball	No occurrence	Check the quantity of solder balls caused after flow soldering. Tamura test board : TP-090 Conveyer speed : 1.3 m/min Preheat : 80-90℃ Solder temperature : 245℃ Soldering time : 4 seconds
24. Stacking quality	No abnormality on the film	No sticking or peeling after sustained loading on top of stacked boards after pre-drying (60℃, 20 minutes) Load: 500g Holding conditions:23℃, 30 %RH, 12 h

*1: Abnormalities are caused on the film at times, depending on the type of flux used. Therefore, use after testing in advance.

4. Cautions in Use

Please refer to the Product Safety Data Sheet.

5. Treatment Process of Boards

5-1 Surface Treatment of Boards

・If oil or moisture sticks to the surface of boards or if the copper foil surface is oxidized, the adhesion of the resist will be reduced. Before coating the resist, therefore, perform surface treatment of the boards:

(Example of polishing)

a) Acid treatment

Acid concentration:	3-5 % H_2SO_4
Duration of acid treatment:	5 to 10 seconds
Spray pressure:	<0.1 MPa

・Thoroughly wash with water after acid treatment.
(Prepare more than three washing tanks, and use fresh water for the last washing tank.)

b) Buff polishing

Revolution:	<1800 rpm
Number of brushes:	2 pieces (#800 + #1000)
Brush pressure:	5 to 10 mm over polishing width

c) Scrub polishing

Slurry abrasive:	"Sakurandom" #220
Slurry concentration:	Approximately 20 %
Slurry discharge pressure:	<0.2 MPa

・Perform the "squeezing out water" after rinsing, using a squeezing roller highly absorbent of water. Furthermore, apply the resist immediately to the boards, to which surface treatment was given. As the holding time after surface treatment is lengthened, the adhesion and heat resistance of the film coat will be reduced. The influence of surface treatment to the film coat is shown in Table 1.

・As shown in Table 3, acid treatment plus buff polishing will give the best results for acid resistance and heat resistance.
・Bad influence to film coat is seen if boards are left standing for a long time after surface treatment. Since the extent of oxidization of copper foil surface will vary according to the environment they are left standing (for examples, high humidity and high temperature). Therefore, apply the resist quickly after surface treatment.

Table 3 Influence of difference in surface treatment to film performance

	Conditions (Room temperature 1 hour)			Cycle of solder heat resistance (260℃, 10 seconds)		
	Immediately after treatment	12 hours later	24 hours later	Immediately after treatment	12 hours later	24 hours later
Acid treatment → Buff polishing	○	○	△	4	4	3
Acid treatment	○	○	△	3	3	2
Buff polishing → Acid treatment	○	○	△	3	3	2
Scrub → Acid treatment	○	○	△	3	3	2
Acid treatment → Scrub	△	△	△	3	3	2
Acid R Buff → Scrub	△	△	△	3	3	2

○: No abnormality on the film
△: Slight peeling on land section

6. Direction

As this product is two components type, mix and stir the main component, DSR-2200TL 05M, and the hardener, CA-2200TL 03H, in a mass ratio of 750 g: 250 g before use. And stir for approximately 30 minutes, then use.
Use the ink within 24 hours after the mixing.

7. Precaution for use

a) For cleaning the screen, use the Cleaner #500, ester or cellosolve type solvent, or a mixed solvent of ester and cellosolve type.

b) Use undiluted ink. In case of any viscosity adjustment, use the specified thinner #313.

c) After the surface treatment of printed wiring boards, avoid any hand grease or stain on the boards and immediately print with the ink and cure it.

d) For drying the film after printing, pre-drying temperature is suitable at 70-78℃, however, the drying condition should be set in advance. Because the temperature depends on shape, heat capacity of a dryer and the number of boards. If the drying is not sufficient, the film is sticky and sticks to the artwork film when in exposure. If the drying temperature is excessively high, it will result in defective development.

e) Use this ink in places to avoid any fire.

f) Use this ink in a well-ventilated working room.

g) Store this ink in a cool place at below 20℃

7-1 Relationship between viscosity and temperature.

Measuring instrument: Brookfield HBT
No.4 rotor

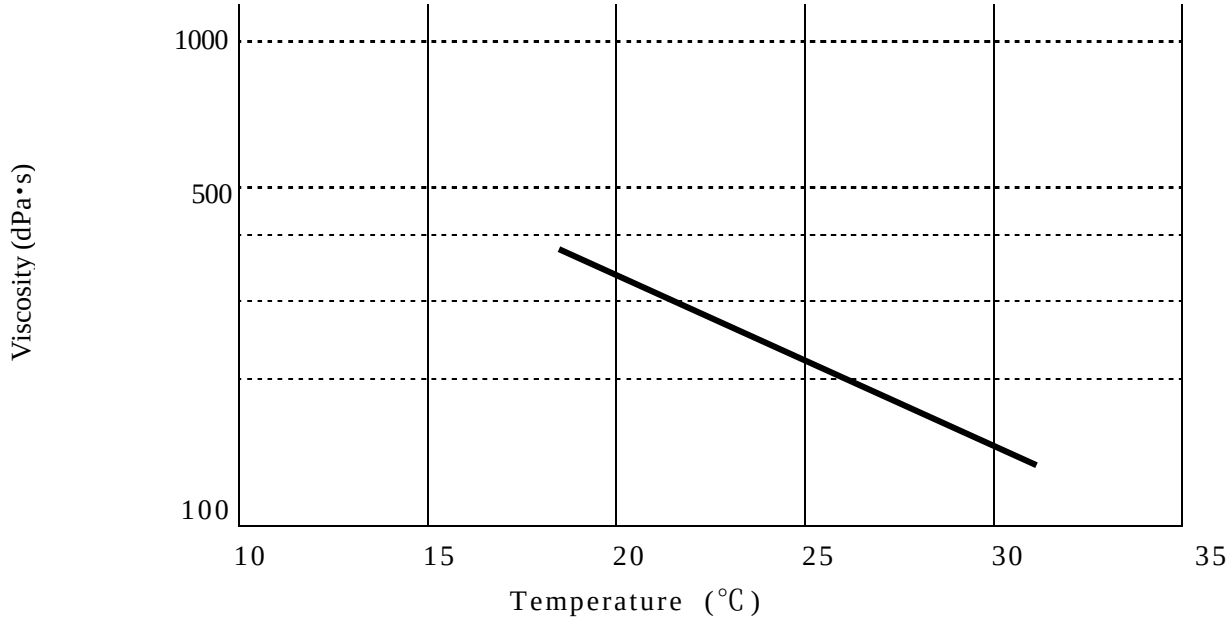


Fig.1 Relationship between viscosity and temperature

7-2 Relationship between viscosity and addition of thinner #313

Measuring instrument: Brookfield HBT
No.4 rotor

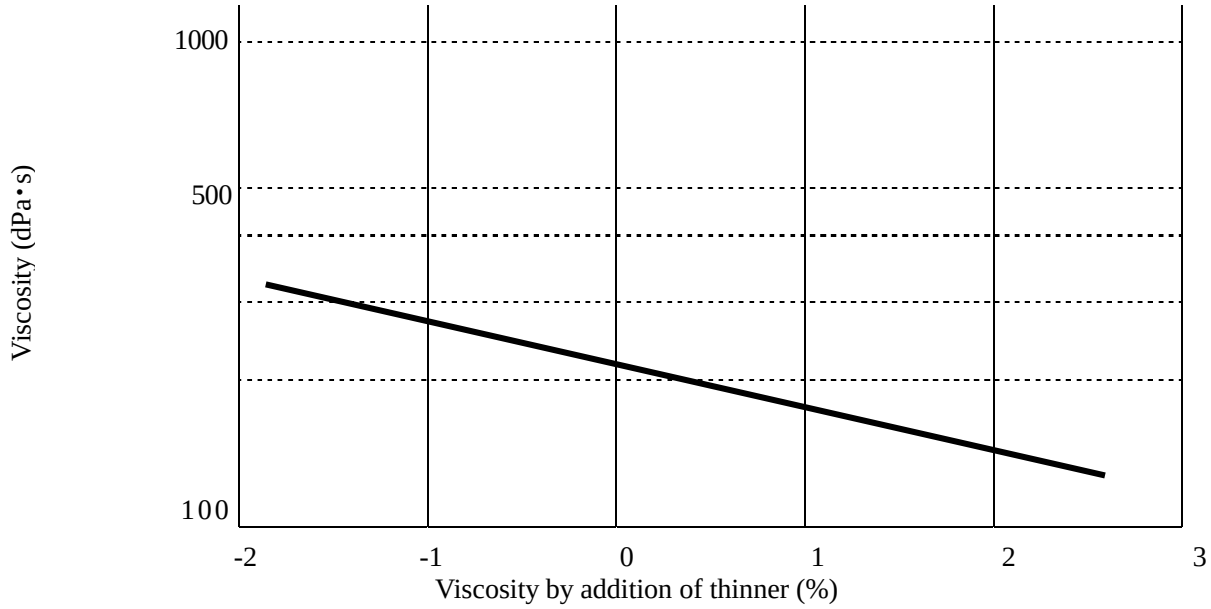


Fig.2 Relationship between viscosity and addition of thinner #313

7-3 Pre-drying

- Bring the resist film into a tack-free condition by evaporating the solvent contained in the resist.
- Fig.3 shows the interrelationship between pre-drying temperature, drying time and the dried condition of the film. (Using drying furnace).
- If the pre-drying of the resist is performed at about 75℃, the quality will be stabilized as the time range of appropriate drying is wide as shown in Fig.3. A circulation type drier having an ample amount of hot air will be the best for ease of drying.
- If the drying temperature is too high or the drying time is too long, this will result in excessive drying to accelerate the heat-hardening reaction, resulting in poor resolution.
- In the case of insufficient drying, the resist will stick to the art work film when exposing or the resist will swell and peel off when developed.
- After the completion of pre-drying, cool down to room temperature and then expose. If the exposure is performed before cooling down, the artwork film may stick to the resist or halation may be increased due to heat fogging.
- Careful about handling after completion of pre-drying lest flaw will be caused as the pencil hardness is less than B.
- The resist can be dissolved and removed by developing solution after drying.
- In case exposure and development are impossible immediately after drying, keep the boards in a cold and dark place and perform exposure and development within three days.

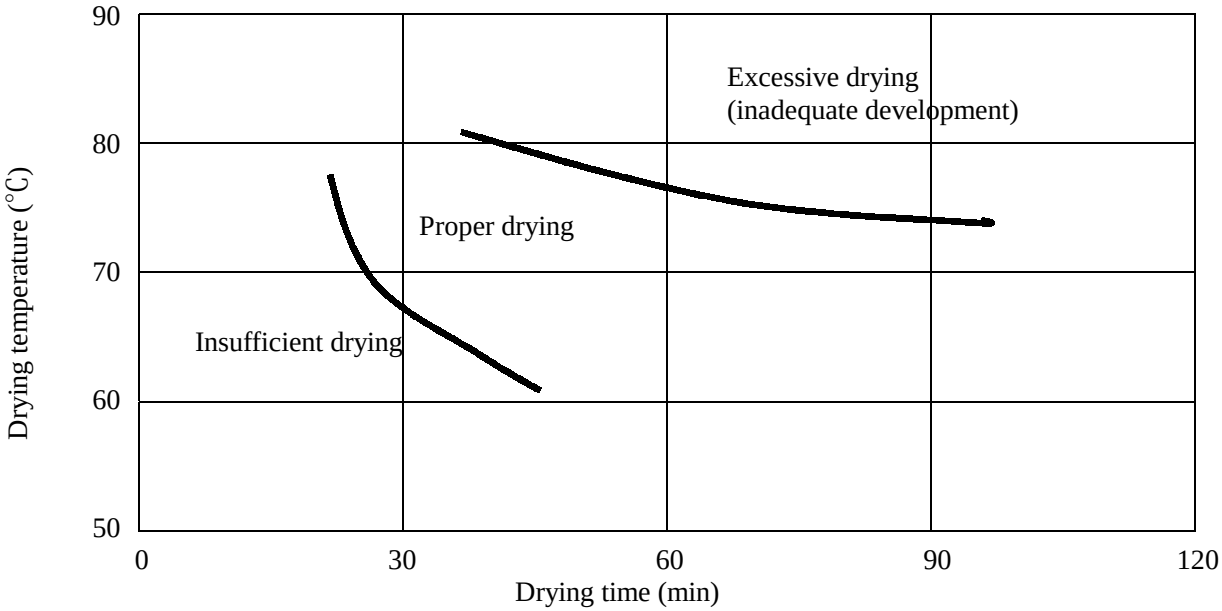


Fig.3 Pre-drying temperature, drying time and the dried condition of the film

7-4 Exposure

- Place the art work film on the resist film surface after drying, perform vacuum contact and irradiate ultraviolet ray.
- Use a metal halide lamp or an extra high-pressure mercury vapor lamp as the light source. Output 5 to 10 kW will be suitable.
- The metal halide lamp has a high ultraviolet ray emission rate and its spectrum is continuous so that it is excellent in hardening the resist film. However, it is slightly inferior in resolution.
- The ultraviolet ray absorption peak of the resist film is in the range from 300 to 450 nm, so check the wave length of the lamp and spectral energy distribution.

Table 4 Sensitivity and resolution of DSR-2200TL 05M using different lamps

Type of lamp		Exposure(mJ/cm^2)		
		300	350	400
Metal halide lamp	Sensitivity	10	11	12
	Resolution	60	60	60
Metal halide lamp with blue filter	Sensitivity	8	9	10
	Resolution	70	70	60

Sensitivity: Step (Kodak step tablet 21)
Resolution: μm

- Required exposure is from 350 mJ/cm^2. If lower than 350 mJ/cm^2 especially lower by more than 300 mJ/cm^2, solder resist surface would be damaged during developing process.
- If the exposure is insufficient, undercut may occur in the film or partially swell out and peel off at the time of development.
- In the case of excessive exposure, halation will take place to worsen development.
- Control the exposure to the lesser side if the film is thin and to greater side if the film is thick.
- If the temperature rise due to exposure exceeds 30℃, the resist will tend to become sticky to the art work film. Therefore, keep the irradiated surface below 30℃.
- If simultaneous exposure is given to double-faced boards, ultraviolet rays will pass through the base material to harden the resist on the back. As a countermeasure against it, use laminated boards containing ultraviolet ray absorbents or improve the design of the circuit. Table 5 shows the transmission factor of ultraviolet rays of various laminated boards:

Table 5 Transmission factor of ultraviolet rays of various laminated boards

Laminated boards		Transmission factors at various wave length (%)		
NEMA standard	Board thickness (mm)	250 nm	310 nm	360 nm
FR-4	1.6	7.8	1.4	8.4
FR-4	0.8	13.8	4.2	17.2
FR-4 (Containing absorbent)	0.8	0	0	0

- Illumination meter, UVX RADIOMETER, (Manufactured by Ultraviolet Products Inc.)
- Measurement of illumination intensity Mean value in 15 seconds

7-5 Post-cure (Heat Curing)

Resist film is already hardened by optical polymerization by exposure to ultraviolet rays. However, in order to perfect the characteristics as solder resist, it is necessary to make the film an insoluble and infusible three-dimensional structure by thermal reaction. Therefore, perform post-cure at 150℃ for 60 minutes, using a hot-air circulation type drying furnace. If post-cure was insufficient, characteristics such as the heat resistance of solder and film hardness cannot be obtained. In case of over post-curing, however, acid resistance will be reduced.

7-6 Marking ink printing

- For heat hardening type marking ink, printing and hardening are possible after development or post-curing.

8.Others

8-1 Re-working method of boards

- For boards after printing, volatilize solvent by performing pre-drying, then peel off with developing solution.
- For boards after pre-drying, peel off with developing solution as they are.
- For boards after exposure or development, the majority of them will peel off if dipped in 3 to 5% NaOH at temperature 40 to 50℃ for 3 to 5 minutes. Use the re-worked boards after giving them surface treatment (acid treatment in H_2SO_4 of approximately 1 % and polishing).

8-2 Working environment

What will largely affect working environment is the temperature, humidity and dust. Avoid temperature below 20℃ or over 30℃ and high humidity over 65 %. Inside a clean room using yellow lamps will be the best.

8-3 Disposal of waste developing solution

As regards the disposal of waste developing solution, use the same way as taken for dry film and conventional resist ink.

9. Experimental data

9-1 Difference in dry film thickness and film performance

Table 6 Relationship between coating weight and hardened film performance

Coating thickness	32μm	38μm
Dry film thickness	19 μm	22 μm
Resistance to solder (260℃, 4 s)	6 cycle	6cycle
Resistance to hot air leveler (240℃, 4 s)	3 cycle	3 cycle
Resistance to solvent (CH_2Cl_2, Room temperature, 30 min)	Passed	Passed
Adhesion	Passed	Passed
Pencil hardness	6H	6H

9-1-1 Relationship between coating weight and dry film thickness

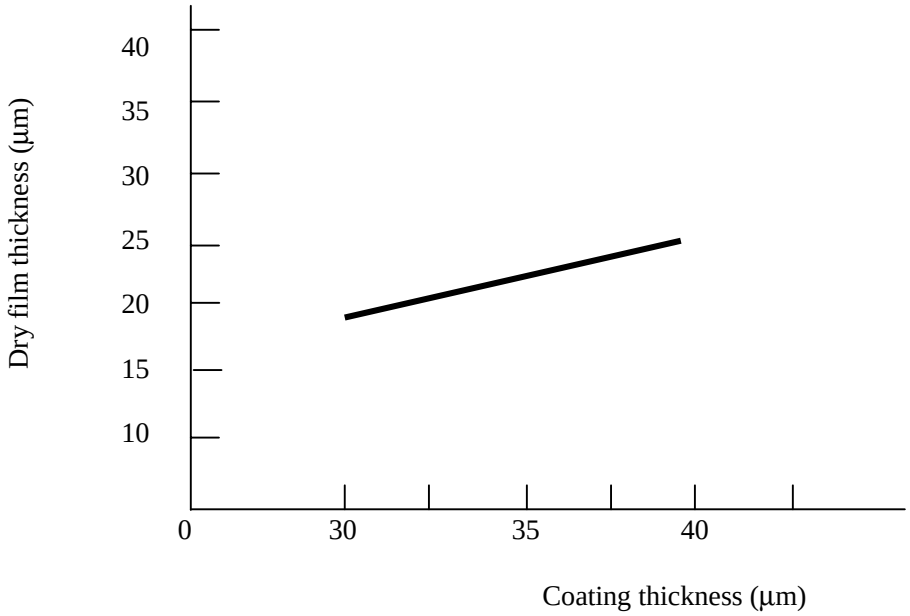


Fig.4 Relationship between coating weight and dry film thickness

9-2 Influence of Pre-drying

9-2-1 Pre-drying time and film hardness

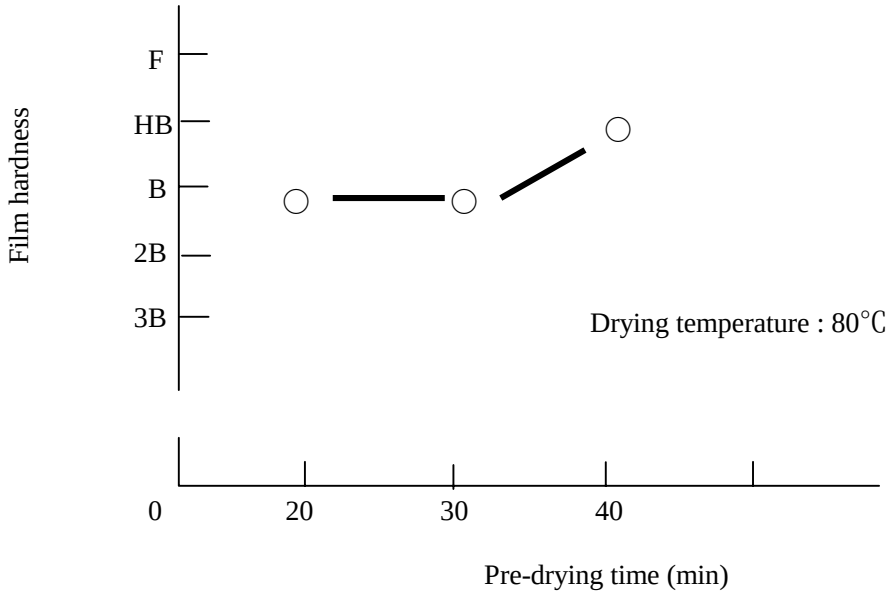


Fig.5 Pre-drying time and film hardness

9-3 Difference in exposure and film performance

Table 7 Relationship between exposure energy and film performance

Exposure energy	300 mJ/cm^2	350 mJ/cm^2	400 mJ/cm^2
Resistance to solder (260℃, 30 s)	5 cycle	5 cycle	5 cycle
Resistance to acid (10 % HCl, Room temperature, 10 min)	Passed	Passed	Passed
Resistance to solvent (CH_2Cl_2, Room temperature, 30 min)	Passed	Passed	Passed
Adhesion	Passed	Passed	Passed
Pencil hardness	6H	6H	6H

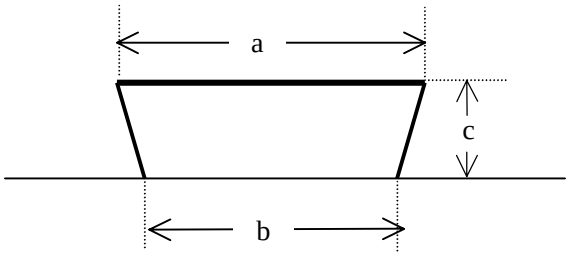
9-3-1 Amount of exposure and undercut and halation

Table 8 Amount of exposure and undercut and halation

Amount of exposure (mJ/cm^2)		300	350	400
Halation		○	○	○
Undercut (μm)	a	121	127	130
	b	112	112	115
	c	35	35	37

(Tamura test pattern TP-081: 100 μm lines between QFP were measured)

Dry film thickness: 40 μm
Developing solution: 1 % Na_2CO_3
Liquid temperature: 30℃
Developing spray pressure: 0.2 MPa
Developing time: 60 seconds



9-4 Difference in post-cure and film performance

Table 9 Relationship between post-cure condition and film performance

Items \ Post-cure condition		150℃ 30 min	150℃ 60 min
Resistance to solder (260℃, 30 s)	30μm	3 cycle	4 cycle
	35μm	4 cycle	5 cycle
	40μm	5 cycle	5 cycle
Resistance to acid (10 % HCl, Room temperature, 10min)	30μm	Passed	Passed
	35μm	Passed	Passed
	40μm	Passed	Passed
Resistance to solvent (CH_2Cl_2, Room temperature, 30min)	30μm	Passed	Passed
	35μm	Passed	Passed
	40μm	Passed	Passed
Adhesion	30μm	Passed	Passed
	35μm	Passed	Passed
	40μm	Passed	Passed
Nikel-gold	30μm	Good	Good
	35μm	Good	Good
	40μm	Good	Good
Pencil hardness	30μm	6H	6H
	35μm	6H	6H
	40μm	6H	6H
Holding time after pre-drying 75℃-50min at 25℃-60%RH in a dark place	1day	Passed	
	2days	Passed	
	3days	Scum	

Note: Test results shown are based on experiments conducted at Tamura Kaken laboratories. However, no guarantee is given for the numeric values.