

Printed Circuit Materials

ASAHI KASEI DFR SUNFORT[®]
AQ-4038

(FULLY AQUEOUS PROCESSIBLE DRY FILM PHOTO RESIST)

BASIC PROPERTIES AND PROCESS RECOMMENDATION

ASAHI KASEI CORPORATION
SUNFORT SALSE DEPT.

ARCAEAST 17F, 2-1,3-CHOME, KINSHI,
SUMIDA-KU, TOKYO, 130-6591, JAPAN

CONTENTS

1. INTRODUCTION

2. STRUCTURE

3. FEATURES

4. BASIC PROPERTIES
IMAGING RESOLUTION PROPERTIES

5. PROCESS RECOMMENDATION

6. SAFETY AND HANDLING PRECAUTIONS

SUNFORT[®] is a registered trademark of ASAHI KASEI CORPORATION.

1. INTRODUCTION

ASAHI KASEI DFR **SUNFORT®** is a dry film photo resist developed by our company with a combination of heretofore-developed technologies in photosensitive materials and plastics, for use in the manufacture of printed circuit boards.

AQ series is a fully aqueous type. The carrier film shall be peeled off before developing.

SUNFORT® AQ-4038 is negative working and an aqueous processability dry film photo resist which is designed to develop completely in a mild alkaline solution such as sodium carbonate (Na_2CO_3) and strip in a dilute alkaline such as sodium hydroxide (NaOH).

SUNFORT® AQ-4038 is high performance photo resist in acid and alkaline etching/plating application and available in resist thickness of $40\mu\text{m}$ sandwiched between layers of polyester and polyethylene film.

2. STRUCTURE

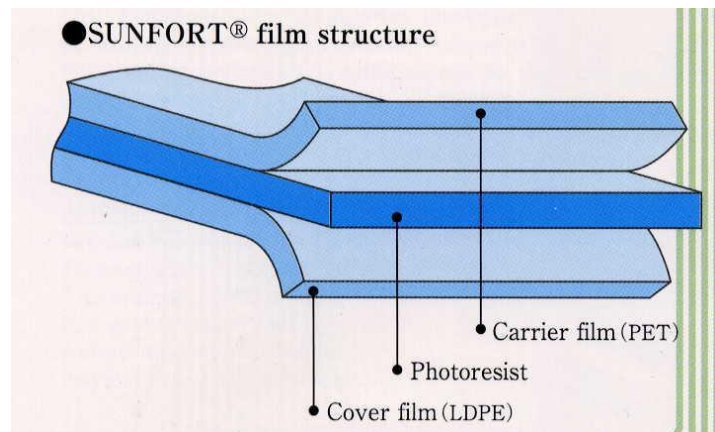
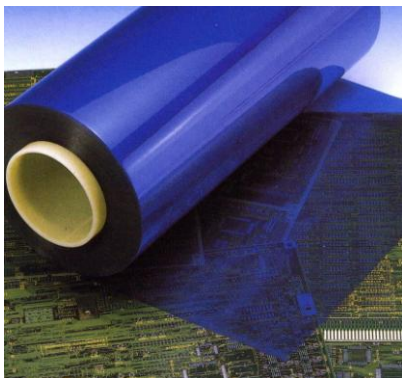


Figure1. Structure of **SUNFORT® AQ-4038**

Film width: Customer size is available in widths ranging from 195 to 600mm in increments of 3mm.

Film length: 180m

3. FEATURES of SUNFORT® AQ-4038

- (1) Wider latitude of exposing and developing conditions.
- (2) High resolution and excellent productivity of photo mask after developing.
- (3) Polymerized resist is tough and has good etching resistance to etchants such as:
 - Ferric chloride (FeCl_3)
 - Cupric chloride (CuCl_2)
 - Alkaline etchant ($\text{Cu}(\text{NH}_3)_4\text{Cl}_2$)
- (4) Polymerized resist has an excellent adhesion to copper surface.
- (5) During stripping, polymerized resist breaks up into small particles and is not soluble in a stripping solution.

4. BASIC PROPERTIES OF AQ-4038

IMAGING RESOLUTION PROPERTIES

(TEST CONDITION)

Base materials	1.6mm thickness, Glass epoxy copper-clad laminate
Copper surface preparation	Buff treatment Scotch- Brite HD#600(3M CO,)
Lamination	Hot roll laminator (ASAHI AL-70)
	Pre-heated panel temp. 30°C
	Laminating roll temp. 105°C
	Roll pressure 0.35MPa (as air cylinder gauge)
	Lamination speed 2.0m/min
Holding time	30min (more than 15min) after lamination
Exposure	5kw super high pressure mercury vapor lamp HMW-201KB (ORC Mfg.) 40-120mJ/cm ²
Development	Conveyorized spray developing machine Developing solution Anhydrous sodium carbonate solution (1.0wt%) Developing temp. 30°C Spray pressure 0.15MPa Developing time 62sec (B.P.=31sec)
Stripping	Conveyorized spray stripping machine Stripping solution Sodium hydroxide solution (3.0wt%) Stripping temp. 50°C Spray pressure 0.20MPa Stripping time 88ec(L.P.=44sec)

(Step tablet)

Our step tablet: Optical density from 0.50 to 1.80, D=0.05

(Our photo mask and step tablet for evaluating resolution)

Our photo mask for evaluating resolution (See figure 2)

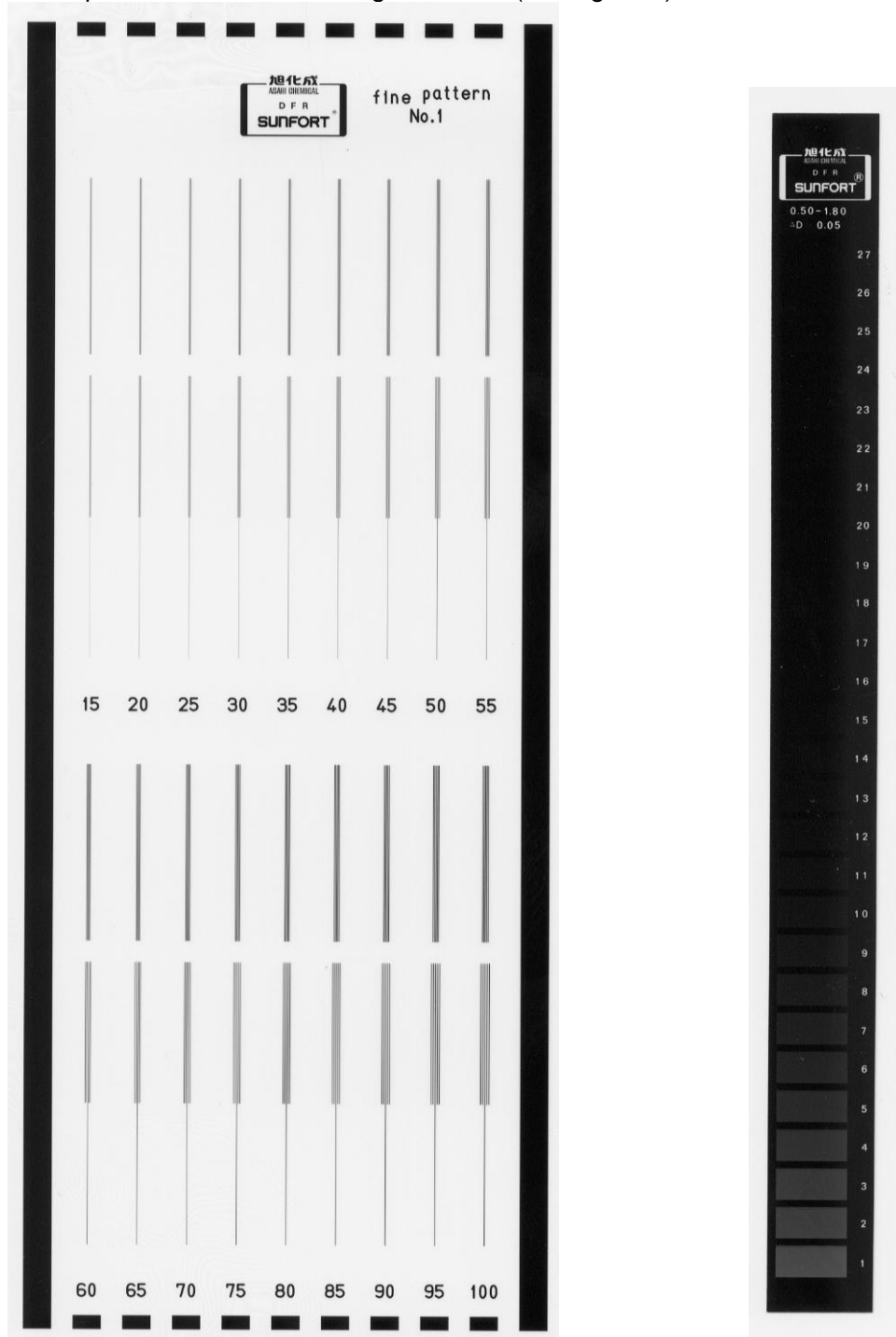


Figure 2. Our photo mask and step tablet

Figure 2. <Result 1.> Relation of exposure energy to step tablet

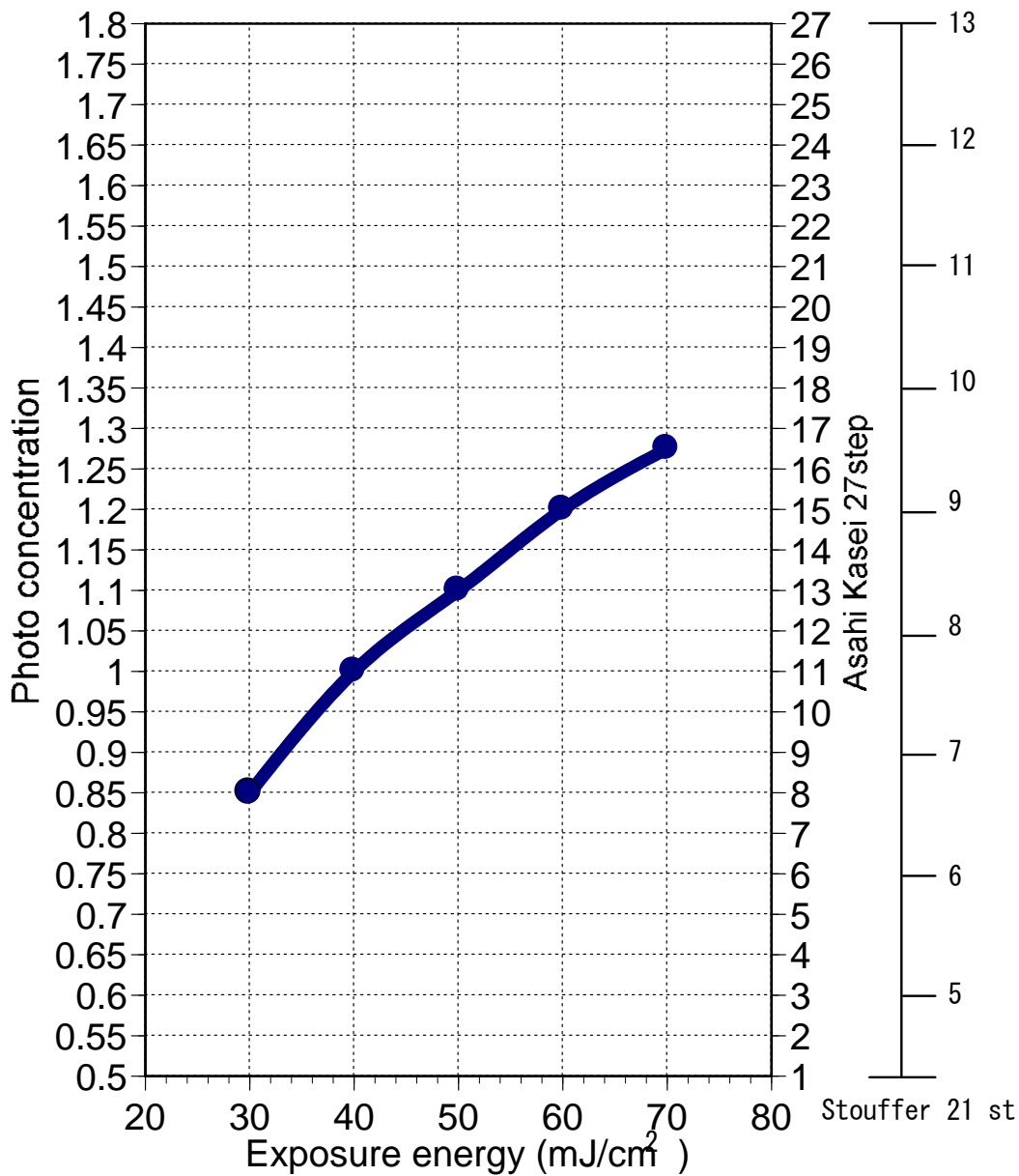


Figure 3 shows the relation of exposure energy to step tablet of SUNFORT® AQ-4038.

(Judgement of step tablet)

Step number is completing covered with dull luster. Judged by STOUFFER 21 step tablet.

(Note)

After the above evaluation, throw sample panels into the developer to see if there are any resist chips on the panel because incomplete polymerized resists sometimes stick to the conveyor roll.

<Results2. > Relation of exposure energy to resolution and reproductivity of developed line width. Figure 4 and 5 show the relation of exposure energy to resolution and reproductivity of developed line width.

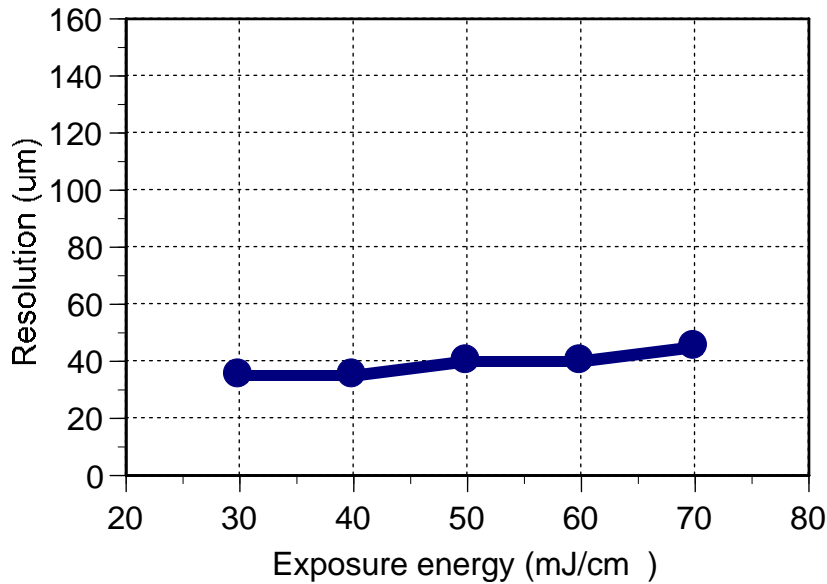


Figure 4 Exposure energy vs. resolution (line width)

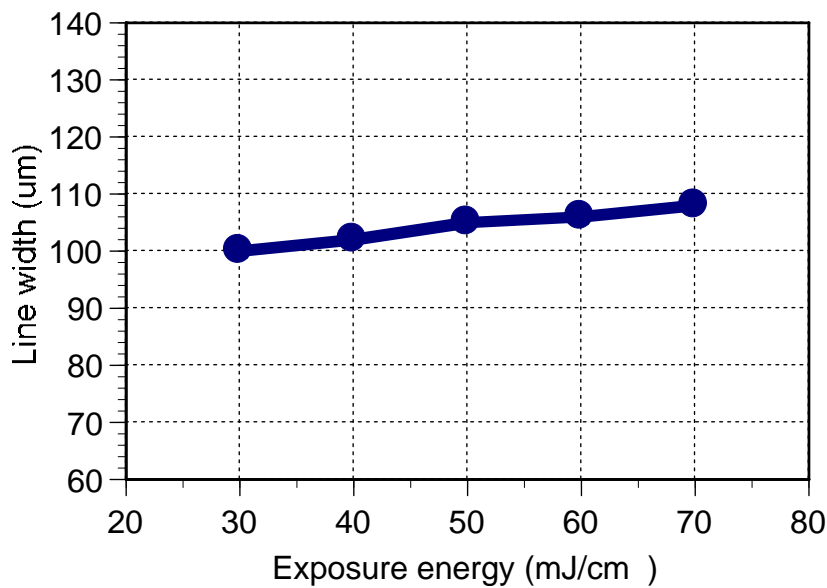


Figure 5. Exposure energy vs. reproductivity of developed line width (100µm line=4mil)

(Judgement of resolution)

The minimum size of developed line or space, which should not flow and be buried by using our photo mask for evaluating resolution. And the minimum resist pattern size is less than $\pm 20\%$ narrow or wide at the highest resolution line.

<Results3. > Relation of exposure energy to resolution and reproductivity of developed space width. Figure 6 and 7 show the relation of exposure energy to resolution and reproductivity of developed space width.

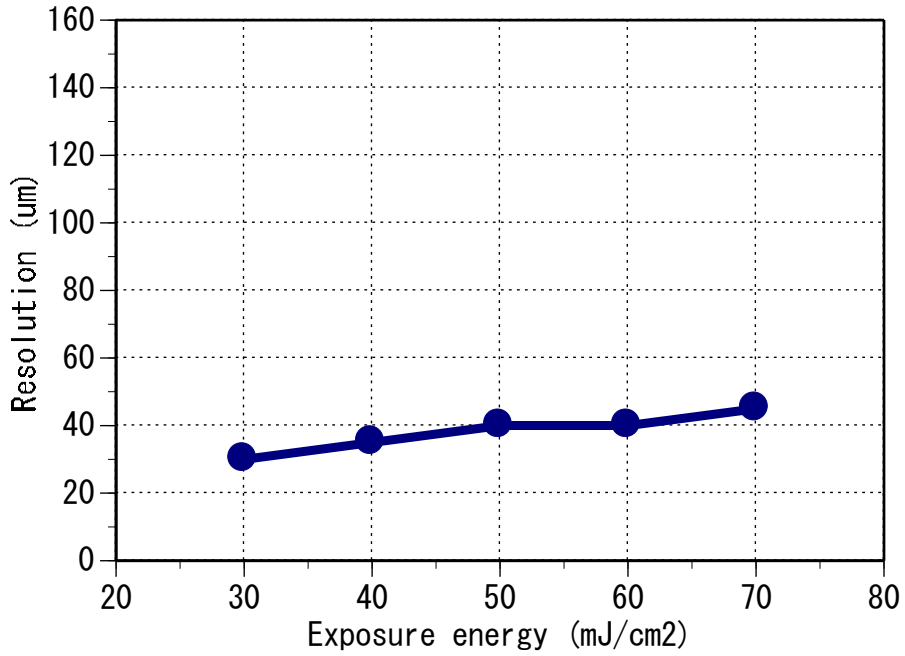


Figure 6 Exposure energy vs. resolution (space width)

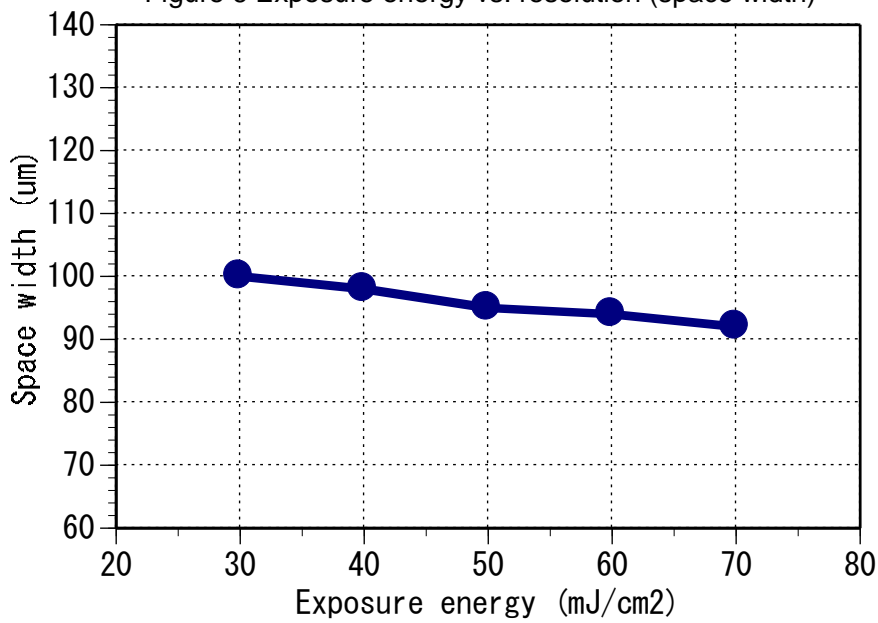


Figure 7. Exposure energy vs. reproductivity of developed space width
(100μm space=4mil)

<Result 4. > Relation of exposure energy to line adhesion and space digging after developing. Figure 8 and 9 show independent line and space digging after developing.

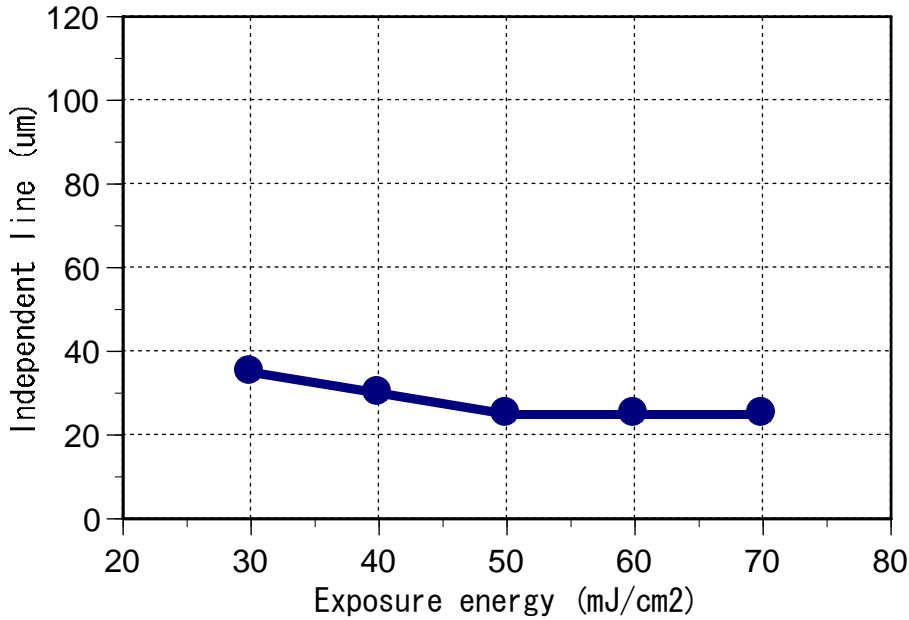


Figure 8. Independent line adhesion after developing

(Judgement of line adhesion)
 The developed line should not flow and be chipped off. Minimum line width 15μm.

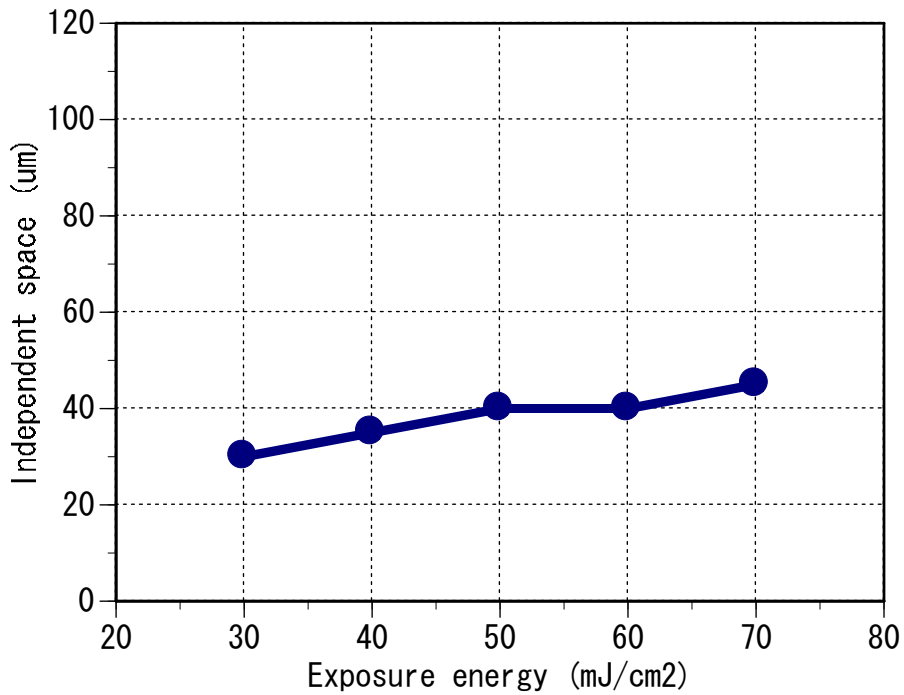


Figure 9. Independent space digging after developing

(Judgement of space digging)
 The developed space should not be buried. Minimum space width 15μm.

5. PROCESSING RECOMMENDATIONS

Table 1 and 2 show representative processing conditions for **SUNFORT® AQ-4038**. Refer them to select optimum conditions, which will vary by customer's equipment.

Table 1. Processing recommendation from board preparation to exposure

Item	Condition	Remarks
1. Board preparation 1-1 Pre cleaning Washing 1-2 Scrubbing Washing 1-3 Drying by air-blower	Conventional cleaners or dilute sulfuric acid (5--10%)	The copper surface should be completely free from moisture, oil, heavy oxidation and contamination's.
2. Lamination 2-1 Preheating the copper surface 2-2 Roll temp. 2-3 Roll pressure 2-4 Speed 2-5 Hold time after lamination	Temp. of copper surface should be 40 to 70°C just before laminating. 105 to 115°C 0.34 to 0.45 MPa (as gauge) (ASAHI AL-70) 1 to 3m/min. More than 15 min. Maximum 3days	Cool to room temp.
3. Exposure 3-1 Exposure energy 3-2 Hold time after exposure	50mJ/cm ² More than 15 min. Less than one day	Super high pressure mercury vapor lamp

Table 2. Processing recommendation from development to stripping

Item	Condition	Remarks
4. Development 4-1 Developing solution 4-2 Solution concentration 4-3 Solution temp. 4-4 Developing time 4-5 Spray pressure of developing zone 4-6 Rinse water temp. 4-7 Rinsing time 4-8 Spray pressure of rinse water zone	Sodium carbonate 1.0±0.2wt% 30°C 62sec. 0.1 to 0.2MPa Below 25°C 62sec. 0.1 to 0.2MPa	(1) Developing time shall be adjusted by BREAK POINT=50-66% (2) Adding antifoam is recommended. (3) Supply and change of developing solution shall be adjusted by the dissolved resist content (0.25m ² /dm ³) in case of the 1.0wt% solution.
5. Stripping 5-1 Stripping solution 5-2 Solution concentration 5-3 Solution temp. 5-4 Stripping time 5-5 Spray pressure of stripping zone 5-6 Rinse water temp. 5-7 Rinsing time 5-8 Spray pressure of rinse water zone	Sodium hydroxide or potassium hydroxide 2.0 to 3.0wt% 50°C More than 88sec. 0.1 to 0.3MPa 20 to 30°C 88sec. 0.1 to 0.2MPa	(1) Stripping time shall be adjusted by LIFTING POINT=50-60% (2) Adding antifoam is recommended. (3) Supply and change of stripping solution shall be adjusted by the stripped resist quantity (0.75m ² /dm ³) in case of the 3.0wt% solution.

(Note) Adjusting of break point and lifting point

1. Break point or lifting point should be set at 1/2 to 2/3 length of developing or stripping chamber.
2. Rinsing time should be more than 1/2 of developing or stripping time.

6. SAFETY AND HANDLING PRECAUTIONS

6-1. STORAGE RECOMMENDATIONS

- (1) **SUNFORT®** should be stored only in cool (5-20°C) and dry (less than 60% at humidity level) areas.
- (2) **SUNFORT®** should be laid horizontally.

6-2. HANDLING PRECAUTIONS

- (1) **SUNFORT®** should be taken out from a black film under yellow safe lights.
- (2) Boards should be covered with black shield-film in case of more than 24-hour hold time after lamination.

6-3. SAFETY PROCEDURES

Take care of the following items; since unpolymerized photo resists contain acrylic monomer, which may cause irritation or allergic reaction to skin.

- (1) In case of contact with skin and clothing, immediately wash with soap and running water. If unpolymerized photo resist or washout solution comes in contact with eyes, immediately flush eyes with plenty of water for at least 15 minutes and consult an oculist.
- (2) Use with adequate ventilation during lamination.
- (3) Not to use cover film (protective polyethylene) after lamination.

(Note) A developing solution (Na_2CO_3) and a stripping solution (NaOH , KOH) should be handled with much care. Wear safety glasses and impervious gloves when making these.

DISCLAIMER OF WARRANTY AND LIABILITY.

All information in this publication is given in good faith and believed to be correct. ASAHI KASEI CORPORATION nevertheless makes no representations or warranties as to its completeness or accuracy.

All information is supplied only on condition that the persons receiving it will make their own determination as to its suitability for their own purposes prior to use. In no event will ASAHI KASEI CORPORATION be responsible for damages of any nature whatsoever resulting from the use of or reliance upon such information or the related product. Nothing contained herein is to be construed as a recommendation to use any product, process, equipment or formulation in conflict with any patent, and ASAHI KASEI CORPORATION makes no representation or warranty, express or implied, that the use thereof will not infringe any patent.

NO REPRESENTATIONS OR WARRANTIES, EITHER EXPRESS OR IMPLIED, OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, OR OF ANY OTHER NATURE. ARE MADE HEREIN WITH RESPECT TO INFORMATION OR PRODUCT.