



Riston[®] DI9300

Data Sheet and Processing Information

Riston[®] Photopolymer Films

PRODUCT FEATURES/ APPLICATIONS

- Negative working, aqueous processable dry film photoresist
- Suitable for print and etch application with acid etching.
- Vivid print out image after exposure for easy inspection.
- Suitable on 355, 405nm and 375-405nm dual band LDI exposure machine.

**PRODUCT DESCRIPTION
(Physical Parameters)**

Available Thickness: 20 μm
25 μm
30 μm

Unexposed Color in Yellow Light: Yellow Green

Exposed Color in Daylight: Blue

Exposed Color in Yellow light: Green

Print-Out (Phototropic) Image: Strong
Contrast to Copper: Strong

Odor: Low

STORAGE

Temperature: 5-21°C (40-70°F)
Relative Humidity: 30 - 70%

SAFE HANDLING

Note safety and industrial hygiene precautions. Consult the Safety Data Sheet (SDS) of any chemical used. SDS's for Riston[®] dry film photoresists are available.

This Data Sheet documents specific process information for Riston[®] DI9300. For more background on general Riston[®] processing see the General Processing Guide.

COPPER SURFACES AND SURFACE PREPARATION

Brush Pumice:

3F or 4F grade, fused, 15-20 % v/v, 9-12 mm (3/8-1/2") brush foot print, fines removal and replenishment per vendor recommendations; high pressure (10 bar) final rinse (pH 6-8); hot air dry.

Jet Pumice:

3F or 4F grade, unfused, 15-20 % v/v, fines removal and replenishment per vendor recommendations; high pressure 10 bar (147 PSI) final rinse (pH 6-8); hot air dry.

Jet or Brush Aluminum Oxide (Al₂O₃):

Follow vendor recommendations. (Generally 20-25%)

Compressed Pad Brushing:

500 grit; 7-9 mm (1/4- 3/8") brush foot print; high pressure (8-10 bar) final rinse (pH 6-8).

Bristle Brushing

500 grit; 7-9 mm (1/4-3/8") brush foot print; final rinse: 2-3 bar, pH 6-8.

Note: Electroplated copper surfaces for tent-and-etch applications are frequently "de-noduled" e.g. by compressed pad brushing prior to pumice scrubbing.

Control Tests:

- Water Break Test: ≥30 seconds
- R_a: 0.1-0.3 μm R_Z: 2-3 μm

To remove antitarnish conversion coatings (e.g. chromate conversion coatings) and/or copper tarnish (oxides), it is recommended to precede pumice or aluminum oxide scrubbing with a spray acid cleaner or 10-15% sulfuric acid or a microetch.

Chemically Cleaned Copper

Alkaline Spray Cleaner (e.g. VersaCLEAN[®] 415) for removal of organic contaminants followed by a spray microetchant (e.g. SureETCH[®] 550) for conversion coating

(chromate) and/or copper oxide removal (about 2-2.5 μm; 80-100 microinch etch). A 10% sulfuric acid spray may be used between alkaline cleaner and microetchant to help with the conversion coating removal. In this case only 1.5 μm (60 microinch) microetch depth is required. To remove residual salts after microetching from the copper surface, an acid rinse or efficient water spray rinsing have been employed successfully. In-line systems for prelamination cleaning may not require an antitarnish treatment after chemical preclean to preserve the cleaned surface. Non-in-line systems with hold times of several hours will require antitarnish. For antitarnish selection: see "Electroless Copper with Antitarnish".

Electrochemically Cleaned Copper

Conveyorized systems combining reverse current electrochemical cleaning and microetching are offered to effectively remove chromate conversion coatings with minimal copper removal. The alkaline electrochemical cleaner first removes trace organics and chromates. After a rinse, a microetch removes about 0.8μm (30 microinches) of copper. Following a second rinse antitarnish may be applied.

Double-Treated Copper Surfaces

Normally no prelamination cleaning required; vapor degreasing or chemical cleaning to remove organics is optional. Tacky roller cleaning recommended to remove particles.

LAMINATION

Lamination Conditions DuPont ASL-24 & ASL-24/Yieldmaster® Film Laminator

• Pre-Heat:	Optional
• Seal Bar Temp.:	60 ± 10°C
• Lam. Roll Pressure:	3.0-5.0 bar (43-72 psig)
• Lamination Temp.:	100 ± 10°C
• Seal Time:	1-4 seconds
• Seal Bar Pressure:	3.5-4.5 bar
• Lamination Speed:	1.5-3 m/min (5-10 ft/min)
• Water Flow Rate, each valve (Yieldmaster® models only):	30 cc/min

Note:

- (1) use distilled water; hard water is acceptable but may cause scale build up and clog nozzles.
- (2) water flow rate need to consult DuPont

Post-Lamination Hold Time

- Panels may be exposed immediately after lamination; however, allow enough time for panels to cool to room temperature before lamination (about 30 minutes; use accumulator in in-line systems).
- Minimize hold time for best tenting performance.
- Maximum hold time (guidelines):
Wet Lamination: 24 hours
Dry Lamination: up to 3 days
Hold times should be determined empirically based on the temperature and relative humidity of the storage area.

Note: Guideline- strip within 5 days after lamination.

Panel Handling/Racking/ Stacking

Preferred: Vertical racking in slotted racks
Less desirable: Stacking

To minimize adverse effects: stack on edge vertically after cooling; avoid dust and dirt trapping between panels; insert unlaminated panel between stack support and first laminated panel to protect laminated panel. Unlaminated support panel should be at least

as big as the laminated panels. Thin flexible innerlayers usually cannot be racked. Preferred techniques: hanging panels vertically or stacking on edge after cool down. If innerlayers are stacked horizontally in trays, the stack height should be limited especially for panels with thin photoresist and fine circuitry.

PERFORMANCE ON FLEXIBLE SUBSTRATES

DI9300 can be used successfully on thin core laminate and flexible substrates.

EXPOSURE

Resolution (Lines & Spaces)

- In Optimized Production Environment (hard contact, high intensity exposure, good development and rinse control): 20 um L/S for 25 um resist
- In Lab Environment:
355nm LDI exposure machine: 18 um L/S for 25 um resist
405nm LDI exposure machine: 18 um L/S for 25 um resist

Exposure Energy vs “Steps Held” For Recommended Exposure Range

Riston® DI9300 355nm LDI mJ/cm ² RST	DI9320 / DI9325 / DI9330 Optimum		
	13-25	13-25	15-29
405nm LDI mJ/cm ² RST	6-12	6-12	6-12
	12-24	12-24	13-27
	6-12	6-12	6-12

- Steps held can vary by +/-1 RST depending on the development breakpoint used. The exposure energy was test based on Lab testing results.

Post-Exposure Hold Time

- At least 30 minutes post-exposure hold time is required for panels developed.
- Maximum post-exposure hold time as a guideline is up to 1 day (24 hrs). 2 days (48 hrs) are allowed but it is not recommended.

DEVELOPMENT

Chemistries/Make-up

- **Sodium carbonate, anhydrous, (soda ash), Na₂CO₃**
Working solution: 0.85 wt%. Use 8.5 g/l (0.071 lb./gal)-10.0 g/l. e.g. for a 100 gallon sump use 7.1 lb.

- **Sodium carbonate, monohydrate;**



Working solution: 1.0 wt%. Use 10 g/l (0.083 lb./gal)-11 g/l. e.g. for a 100 gallon sump use 8.3 lb.)

- **Potassium carbonate (potash; K₂CO₃)**

For make up use either potassium carbonate powder, i.e. anhydrous (potash) K₂CO₃ or a liquid concentrate such as DuPont D-4000 developer (40% concentrate):

Working solution: 1.0 wt%. For 100 liter solution use 1.5 liter of D-4000 or 3;.23 Kg of anhydrous potassium carbonate (For 100 gal solution use 1.5 gal of D-4000 or 7.1 lb. of anhydrous potassium carbonate).

Equations to calculate required amounts for desired wt% of working solutions:

- Na₂CO₃:
kg Na₂CO₃ = wt% x sumpx vol liters x 0.01
lb. Na₂CO₃ = wt% x sump x vol gallons x 0.083
- D-4000: liters (or gallons)
D-4000 = wt% x sump x vol liters
(or gallons x 0.018)
- K₂CO₃:
kg K₂CO₃ = wt% x sump vol liters x 0.01
lb. K₂CO₃ = wt % x sump vol gallons x 0.083

Control Test:

Titration of fresh developer solution (e.g. 25ml), before defoamer addition, with 0.1 N HCl to the Methyl Orange end point.

$$\text{wt\%} = \text{N} \times \text{ml HCl} \times \text{FFX80} \times \text{ml Sample}$$

(N= acid normality; FW = formula weight)

FW of Na ₂ CO ₃	=106
FW of Na ₂ CO ₃ •H ₂ O	= 124
FW of K ₂ CO ₃	= 138

Defoamers

Riston® DI9300 may require antifoam dependent on water quality, carbonate purity, photoresist loading, and equipment design. If required, add 0.80 ml/liter (3 ml/gallon) of

FoamFREE™ 940, or equivalent polyethylene-polypropylene glycol block co-polymer.

- For batch operation: add defoamer during initial make up;
- For automatic replenishment systems: add defoamer directly to the sump in a high turbulence area at a predetermined rate.

Do not add defoamer to the supply tank or to the replenishment solution.

Development conditions

- Spray Pressure: 1.0-2.0 bar (14-30 psig)
- Spray Nozzles: high impact direct-fan nozzles preferred; a combination of cone and fan nozzles may be preferred if film tent breakage is experienced.
- Chemistry:
 - Na₂CO₃: 0.85-1.0 wt%; 0.85 wt% preferred
 - Na₂CO₃•H₂O: 1.0-1.1 wt%; 1.0 wt% preferred
 - K₂CO₃: 1.0-1.1 wt%; 1.0 wt% preferred
- Temperature: 27-35°C (80-95°F); 30°C (85°F) preferred
- **Dwell Time**
 - Breakpoint: 40-60 %
 - Time in Developer (Dwell Time), at 1.4 bar (20 psig) spray pressure, 50% breakpoint. 30°C, fresh developer solution at recommended carbonate concentrations
 - Riston® DI9320: 28 seconds
 - Riston® DI9325: 36 seconds
 - Riston® DI9330: 42 seconds

NOTE: Total time in developer = Time to clean divided by Breakpoint

- Time to Clean (time in developer to wash off unexposed resist): 18 seconds for Riston® DI9325 depending on conditions.
- Shorter times to clean are achieved at higher temperatures, higher carbonate concentrations, and higher pressures.
- If developer conveyor speed is too fast for match with other in-line equipment: lower soda ash concentration down as far as 0.5wt%. Consider lowering temperature. Do not lower spray pressure below recommended levels.

Resist Loading

Resist loading: 0-0.3 mil-m²/l(0-12 mil-ft²/gal)

Note: this range gives a fairly constant time to clean; lower loadings result in shorter time to clean; higher loadings increase the time to clean.

Rinsing & Drying Recommendations

- Rinse water: hard water (150-250 ppm CaCO₃ equivalent). Softer water can be hardened by the addition of calcium chloride or magnesium sulfate. If hard water is not available, a first soft water rinse may be followed by a dilute acid rinse, followed by a water rinse.
- Rinse temperature: 15-25°C (60-80°F)
- Rinse spray pressure: 1.4-2.4 bar (20-35 psig). Use high impact, direct-fan nozzles.
- Effective Rinse Length: 1/3-1/2 of length of developer chamber; >1/2 preferred.
- Drying: blow dry thoroughly; Hot air preferred

Controls:

- For batch processing: adjust conveyor speed to maintain desired breakpoint; dump developer solution when development time has become 50% longer than for fresh solution.
- Developer conveyor speed: see “**Dwell Time**”.
- Feed & Bleed: to keep loading at about 0.2 mil-m² l (8 mil-ft²/gal), activate addition of fresh developer at pH 10.5; stop addition when pH 10.7 is reached.

Hold Time after Development before etching 0-3 days

Note: minimize white light exposure during post development hold to prevent film embrittlement.

Developer Maintenance

Clean at least once a week to remove resist residue, calcium carbonate (scale), defoamer, and dye from developed resist. Dye build-up can be minimized by the use of anti-foam.

- Time to strip increases with white light exposure. A 20% increase in strip time over 8 day's exposure is not unusual.
- Higher levels of exposure increase Time-to-Strip: Slightly

ETCHING

- Riston® DI9300 series resists are compatible with most acid etchants, e.g. cupric chloride (free HCl normality ≤ 3.0 N), H_2O_2/H_2SO_4 , and ferric chloride.

Defoamers

Additives for foam control may not be required depending on equipment design and operation. However, if defoamer is needed, use DuPont FoamFREE™ 940 at 0.8 ml/ liter (3 ml/gallon) for resist loading up to 0.6 mil-m²/liter (25 mil-ft²/gal).

STRIPPING

Aqueous Caustic (NaOH or KOH) ConveyORIZED Stripping

- Stripper Dwell Times (seconds) at 55°C (130°F), 1.7 kg/cm² (25psig), over recommended exposure range:

	DI9320	DI9325	DI9330
3.0 wt% NaOH	46 sec	65 sec	95 sec

Note:

Data from lab testing result

Note:

- Dwell Time = 2x Time to strip (TTS) resist
- High caustic concentrations produce larger skin sizes and higher loading capabilities.
- KOH generally produces smaller skin sizes than NaOH.

Particle Size at 3.0% NaOH: sheet

Solubility of Stripped Particles

: Non-Soluble

• Physical Characteristics of Stripped Particles (e.g. Stickiness): Non sticky

Controls/ Solution Maintenance:

- Preferred: Continuous replenishment (feed & bleed) using board count. Maintain resist loading at ≤ 0.4 mil-m²/liter (≤ 15 mil-square feet/ gallon).
- Batch: up to 0.5 mil-m²/liter (20 mil-square feet/ gallon). Maintain breakpoint at $\leq 50\%$ by lowering conveyor speed or by starting batch stripping with a lower breakpoint and changing the solution once breakpoint moves above 50%. However, low breakpoints can lead to attack of solder on plated work, or cause copper oxidation.

Filtration Systems

Spray stripping equipment should contain a filtration system to collect and remove resist skins to avoid nozzle clogging, to extend stripper life, and to avoid resist skins from reaching the rinse chamber. The most effective filter systems collect the stripper skins immediately after they were generated, before entering recirculation pumps, and they feature continuous removal of skins from the stripper solution.

Equipment Cleaning

- Cleaning of Equipment Drain and flush with water. Fill unit with 5 wt% KOH or NaOH, heat to 55°C (130°F), and circulate (spray) for 30 minutes to dissolve photoresist

- Higher stripping temperature increases the stripping rate.
- Stripping rate can be increased with higher impact sprays. Use higher pressures and/or high-impact spray nozzles. Avoid low impact deflector nozzles.

particles. Then drain the unit. Repeat procedure if required to remove heavy residues. Remaining blue dye stains on equipment may be removed by circulating 5 vol.% HCl at 55°C (130°F) for 30 minutes (HCl can damage stainless steel). Then drain the unit, fill with water, recirculate for 30 minutes, and drain. There are also proprietary cleaners available which may offer better results.

Proprietary Strippers

Are used for higher strip speed, higher resist loading, to minimize chemical attack on tin or tin/lead, or to reduce copper oxidation, e.g. to facilitate AOI.

Reworking Panels for Re-use

Stripped panels may contain organic residues from photoresist or defoamers. After stripping, regenerate a fresh copper surface as follows, before mechanically cleaning the panels:

- Soak for three minutes in a hot soak cleaner at the recommended temperature.
- Rinse thoroughly.
- Etch 0.13 µm (5 microinches) of copper if panels are deeply oxidized.
- Rinse thoroughly.
- Dip in 5-10% sulfuric acid.
- Rinse thoroughly
- Dry

SAFE LIGHTING

- Protect photoresist through lamination and development steps from UV radiation and visible light up to 450 nm by use of yellow, amber or gold fluorescent “safe lights”.
- High intensity (≤ 70 footcandles) yellow “safe light” causes a change in steps held and should be avoided.

WASTE DISPOSAL

For questions concerning disposal of photoresist waste refer to the latest DuPont

literature and Federal, State, and Local Regulations.

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