

DuPont™ Riston® LDI7100 Series

PHOTOPOLYMER FILMS

Data Sheet & Processing Information

Product Features/Applications

- Negative working, aqueous processable polymer film
- Suitable for UV-LASER 355nm Direct Imaging
- Print & Etch with Acid and Alkaline Etching
- Print, Plate and Etch applications with Copper/Tin/Tin-Lead acid plating

Product Description (Physical Parameters)

Available Thickness:	30µm, 38µm and 50µm
Unexposed Color in Yellow Light:	Green
Exposed Color in Daylight:	Blue
Exposed Color in Yellow Light:	Green
Print-Out (Phototropic) Image:	Strong
Contrast to Copper:	Strong
Odor:	Low

This Data Sheet documents specific process information for DuPont™ Riston® LDI7100 series. 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.

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 (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
- Ra: 0.10–0.3µm Rz: 2–3µm

Chemically Cleaned Copper

Alkaline Spray Cleaner for removal of organic contaminants followed by a spray microetchant for conversion coating (chromate) and/or copper oxide removal (about 2–2.5µm; 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 1.5µm (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.

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 an 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

Hot Roll Laminators

- Pre-Heat: Optional
- Roll Temperature: $115^{\circ}\text{C} \pm 5^{\circ}\text{C}$ ($240^{\circ}\text{F} \pm 10^{\circ}\text{F}$)
- Roll Speed: 0.6–1.5 m/min (2–5 ft/min)
- Air Assist Pressure: 0–2.8 bar (0–40 psig)

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 15 minutes; use accumulator in in-line systems).
- Minimize hold time for best tenting performance.
- Maximum hold time (guidelines):
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.

Laminator Conditions

Automatic Cut Sheet Laminator

- Seal Bar Temp: $60 \pm 10^{\circ}\text{C}$ ($140 \pm 18^{\circ}\text{F}$)
- Lam. Roll Pressure: 3.0–5.0 bar (43–72 psig)
- Lamination Temp: $115 \pm 5^{\circ}\text{C}$ ($240 \pm 10^{\circ}\text{F}$)
- Seal Time: 1–4 seconds
- Seal Bar Pressure: 3.5–4.5 bar (50–65 psig)
- Lamination Speed: 1.5–3 m/min (5–10 ft/min)

Note: Reduced lamination roll pressure and/or temperature may be required in tenting application to avoid tent breakage and resist flow into through-holes.

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

DuPont™ Riston® LDI7100 can be used successfully on thin core laminate and flexible substrates.

Exposure

Resolution (Lines & Spaces)

- In Optimized Production Environment by LDI with good development and rinse control): 40 micron (1.5 mil) L/S
- In Lab Environment: 30 micron (1.25 mil) L/S

Exposure Energy vs “Steps Held” For Recommended Exposure Range

Riston® LDI7100	LDI7130	LDI7140	LDI7150
mJ/cm ²	10–20	10–20	15–25
RST	10–16	10–16	10–16
SST	6–7	6–7	7–8

- Steps held can vary by +/-1 RST depending on the development breakpoint used.
- Energy is measured by H-line energy.

Frame Operation:

- Panel should be flat enough on exposure stage

Development

Chemistries/Make-up

- **Sodium carbonate, anhydrous, (soda ash); Na₂CO₃**
Working solution: 0.85 wt%. Use 8.5 g/l (0.071 lb./gal); e.g. for a 100 gallon sump use 7.1 lb.)
- **Sodium carbonate, monohydrate; Na₂CO₃·H₂O**
Working solution: 1.0 wt%. Use 10 g/l (0.083 lb./gal); 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: Working solution: 1.0 wt%. For 100 liter solution use 1.5 liter of 40% concentrate or 0.86 kg of anhydrous potassium carbonate (For 100 gallon solution use 7.1 lb. of anhydrous potassium carbonate).

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

- **Na₂CO₃:**
 $\text{kg Na}_2\text{CO}_3 = \text{wt\%} \times \text{sump volume liters} \times 0.01$
 $\text{lb. Na}_2\text{CO}_3 = \text{wt\%} \times \text{sump volume gallons} \times 0.083$
- **K₂CO₃:**
 $\text{kg K}_2\text{CO}_3 = \text{wt\%} \times \text{sump volume liters} \times 0.01$
 $\text{lb. K}_2\text{CO}_3 = \text{wt\%} \times \text{sump volume gallons} \times 0.083$

Control Test

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

$$\text{wt\%} = \text{HCl N} \times \text{ml HCl} \times \text{FW} / \text{ml Sample Volume} \times 20$$

(N=acid normality; FW = formula weight)

$$\begin{aligned} \text{FW of Na}_2\text{CO}_3 &= 106 \\ \text{FW of Na}_2\text{CO}_3 \cdot \text{H}_2\text{O} &= 124 \\ \text{FW of K}_2\text{CO}_3 &= 138 \end{aligned}$$

Defoamers

Riston® LDI7100 has been successfully used without defoamer. The need for defoamer and the amount required are dependent on water quality, carbonate purity, photoresist loading, and equipment design. If required to control foam, add 0.8–1.3 ml/liter (3–5 ml/gallon) of 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 pre-determined rate.

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

Development Conditions

- Spray Pressure: 1.4–2.4 bar (20–30 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: 0.7–1.0 wt%; 0.85 wt% preferred
 - Na₂CO₃•H₂O: 0.8–1.0 wt%; 0.9 wt% preferred
 - K₂CO₃: 0.8–1.0 wt%; 0.9 wt% preferred
- Temperature: 27–32°C (80–90°F) preferred

Dwell Time

- Breakpoint: 50–65%
- Time in Developer (Dwell Time), at 1.4 bar (20 psig) spray pressure, 50% breakpoint, 30°C, fresh developer solution recommended carbonate concentrations

Riston® LDI7130: 20–26 Seconds

Riston® LDI7140: 25–30 Seconds

Riston® LDI7150: 45–50 Seconds

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

- Time to clean (time in developer to wash off unexposed resist): 25 seconds for Riston® LDI7150.
- Shorter times to clean are achieved at higher temperatures, higher carbonate concentrations, and higher pressures.
- If developer conveyor speed is too fast for a match with other in-line equipment: lower soda ash concentration down as far as 0.5 wt%. Consider lowering temperature. Do not lower spray pressure below recommended levels.

Resist Loading

- Resist Loading: 0–0.4 mil-m²/liter (0–12 mil-ft³/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 preferred (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 (20–30 psig). Use high impact, direct-fan nozzles.
- Effective Rinse Length: Minimum of 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/liter (8 mil-ft²/gal), activate addition of fresh developer at pH 10.5; stop addition when pH 10.7 is reached.

Developer Maintenance

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

Etching

- Riston® LDI7100 series resists are compatible with most acid etchants and alkaline etchants.

Plating

(Acid Copper Sulfate)

- Riston® LDI7100 series resists can be used for pattern plating processes with acid copper. Riston® LDI7100 has very good resistance to lifting and underplating.

Recommendations: Preplate Cleaning Process Sequence

- Acid Cleaner: 38–50°C (100–120°F); 2–4 minutes
- Spray and/or Tank Rinse: 2 minutes
- Micro-etch to remove 0.15–0.25 µm (5–10 microinches) copper (time: as required)
- Spray and/or Tank Rinse: 2 minutes
- Sulfuric acid (5–10 vol %) dip; 1–2 minutes
- (Optional: spray rinse; 1–2 minutes)

Stripping

Aqueous Caustic (NaOH or KOH) Conveyorized Stripping

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

3.0 wt%	LDI7130	LDI7140	LDI7150
NaOH	30–35 sec	40–50 sec	50–70 sec

Note:

- Dwell Time = 2x Time to strip resist
- High caustic concentrations produce larger skin sizes and higher loading capabilities
- KOH generally produces small 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
- 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.
- Time to strip increases with white light exposure. A 20% increase in strip time over eight days exposure is not unusual.
- Higher levels of exposure increase Time-to-Strip: Slightly

Defoamers

Additives for foam control may not be required depending on equipment design and operation. However, if defoamer is needed, use polyethylene-polypropylene glycol block copolymer at 0.8 ml/liter (3 ml/gallon) for resist loadings up to 0.6 mil-m²/liter (25 mil-ft²/gallon).

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 are 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 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 the 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) or copper if panels are deeply oxidized
- Rinse thoroughly
- Dip in 5–10% sulfuric acid
- Rinse thoroughly
- Dry

Storage

Temperature: 5–21°C (40–70°F)

Relative Humidity: 30–70%

Safe Handling

Note safety and industrial hygiene precautions. Consult the Material Safety Data Sheet (MSDS) of any chemical used. MSDS's for DuPont™ WB Series Micrographic Film are available from your DuPont Representative.

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 (>75 foot-candles) yellow "safe light" can cause a change in photospeed over time) 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.

For more information, please contact your local representative, or visit our website for additional regional contacts.

www.imaging-materials.dupont.com

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K-25922 07/12



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