DuPont™ Riston® 200 Series

DATA SHEET & PROCESSING INFORMATION

Product Description
(Physical Parameters)

- Negative working, aqueous processable dry film photoresist
- Suitable for pattern plate applications on scrubbed and unscrubbed electroless copper and most Direct Plate surfaces.
- Suitable for print and etch application with acid or alkaline etching.
- Suitable for some gold plating applications.
- Suitable for some photochemical machining (chemical milling) application.
- Suitable for tent-and-etch applications.

Available Thickness:	38 microns (1.5 mil) 50 microns (2.0 mil)
Unexposed Color in Yellow Light:	Green
Exposed Color in Yellow Light:	Dark Green
Exposed Color in White Light:	Blue
Print-Out (Phototropic) Image:	Strong
Contrast to Copper:	Strong
Odor:	Low

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PART 1: Copper Surfaces and Surface Preparation

Electroless Copper Surfaces
Post-Electroless Rinsing/ Drying

- Drag-out rinse: 1 minute; stagnant, to remove most of the copper solution.
- Counterflow rinse: 2 tanks, 2 minutes each, air sparged.
- Heated (stagnant) rinse: 3 minutes; 50-65°C (120-150°F) for removal of residual electroless.
- Neutralization/ Passivation: 5 minutes, 5 vol% sulfuric acid+ 5 wt% citric acid or commercial antitarnish.
- Counterflow rinse: 2 tanks, 2 minutes each, air sparged.
- Deionized water rinse: 1 minute, pH 5-7.
- Drying: Blow dry (uniform, stain-free copper); followed by 5-10 minutes oven drying at 60-65°C (140-150°F) if needed to completely remove moisture from holes.

Unscrubbed Electroless Copper

No antitarnish applied

Riston® 200 can be laminated to unscrubbed electroless copper with or without anitarnish.

Minimize prelamination hold time (<4 hours) to avoid oxidation and recontamination, with no antitarnish.

Regeneration of surface after excessive (≥4 hrs.) hold times:

1. Hot soak panel for 3 minutes
2. Rinse thoroughly
3. Etch 0.13 µm (5 microinches) of copper
4. Rinse thoroughly
5. Dip in 5-10% sulfuric acid / 5 vol% citric acid

Antitarnish Applied

The following antitarnishes have been used successfully per manufacturers recommendations:

- Enthone Enteck Cu56

Scrubbed Electroless Copper Surfaces

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 (Al_2O_3):

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 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: 0.10-0.3 µm

Direct Plate (Metallization)

A variety of Direct Plate processes are in use as alternatives to the formaldehyde based electroless process. Dry film adhesion and/or plating bath compatibility should be confirmed. Some Direct Plate processes are preceded by a microetch to remove activator (catalyst) from copper surfaces. This produces a smooth copper surface especially when more than 0.8 µm (30 microinches) are removed.

Vendor Copper (Print & Etch)

Scrubbed Vendor Copper

See: "Scrubbed Electroless Copper Surface" for scrubbing step.

To remove vendor applied 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 Vendor Copper

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

PART 2: Lamination

Lamination Conditions DuPont HRL-24 & HRL-24/YieldMaster® Film Laminator	
• Pre-Heat:	Optional
• Roll Temperature:	105°C ±5°C(221 ±9°F)
• Roll Speed:	0.6-1.5 m/min (2-5 ft/min)
• Air Assist Pressure:	0-2.8 bar (0-40 psig)
Note: for 1•4 bar use heavy-duty rolls)	
• Water flow Rate, each valve (YieldMaster® models only) : 5 – 15 cc/min	

Note: use distilled water; hard water is acceptable but may cause scale build up and clog nozzles.

Lamination Conditions DuPont ASL-24 & ASL-24/YieldMaster® Film Laminator	
• Seal Bar Temp.:	65 ±15°C (150 ±27°F)
• Lam. Roll Pressure:	3.0-5.0 bar (43-72 psig)
• Lamination Temp.:	105 ± 10°C (220 ± 18°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)
• Water Flow Rate, each valve (Yieldmaster® models only):	5-15 cc/min

***Note*:** use distilled water; hard water is acceptable but may cause scale build up and clog nozzles.

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

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):
  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.

PART 3: Tenting

Riston® 200 has been designed to provide excellent tenting in both plating and etching processes. Tents of 6.3 mm (250 mil) or larger can be tented. For large holes best yields are obtained with the Riston® 220. For best results minimize hold time between lamination and exposure, use optimized developer conditions, reduce possible handling damage , and optimize board deburring. Tent failure rates below 1.0% should be possible in most applications.

PART 4: Exposure

Resolution (Lines & Spaces; L/S)
• In Optimized Production Environment (hard contact, high intensity exposure, good development and rinse control): 75 micron (3 mil L/S)
• In Lab Environment: 50 micron (2 mil L/S)

Phototool (5 mil) Line Reproduction with Riston® 200		
1:1 Reproduction ± 2 micron (0.080 mils) from nominal		
215	RST	12 - 18
220	RST	12 - 20

Note: DuPont PC-530 a medium collimated light exposure unit.

Exposure Intensity

- ≥5 mW/cm² at the photoresist surface for 200-250 µm (8-10 mil) L/S resolution; higher intensities are desirable for finer L/S.

Exposure Energy vs "Steps Held" For Recommended Exposure Range		
Riston®	215	220
mJ/cm²	35-90	45-100
RST	12-20	12-20
SST	8-10	8-10

- Steps held can vary by +/-1 RST depending on the development breakpoint used
- If panels are exposed when warm, there may be a slight increase in the steps held.

Note:

- RST = DuPont Riston® 25-Step Density Tablet;
- SST = Stouffer 21-Step Sensitivity Guide;
- "Step Held" = last step covered •50% with photoresist.

Vacuum Frame Operation

- Contact Mode:
  Preferred: Hard Contact
- Check for small, immovable Newton's Rings as an indicator of good contact between the panel, phototool, and vacuum frame cover
- Use air bleeder veins to channel air to vacuum port and reduce vacuum drawdown time.
- Bleeder Vein Thickness: same as panel

PART 5: Development

Chemistries/Make-up
• **Sodium carbonate, anhydrous, (soda ash), Na_2CO_3** Working solution: 0.85 wt%. Use 8.5 g/l (0.071 lb./gal)
• **Sodium carbonate, monohydrate; $Na_2CO_3 \cdot H_2O$** Working solution: 1.00 wt%. Use 10 g/l (0.083 lb./gal)
• **Potassium carbonate (potash; K_2CO_3)** For make up use either potassium carbonate powder, i.e. anhydrous (potash) K_2CO_3 or a liquid concentrate such as DuPont D-4000 developer (40% concentrate): Working solution: 1.0 wt%. Use 0.018 liter of D-4000 per liter of sump, or use 10g/liter (0.083 lb/gal) of anhydrous potassium carbonate.

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

- Na_2CO_3: kg Na_2CO_3 = wt% x sump vol liters x 0.01 lb. Na_2CO_3 = wt% x sump vol gallons x 0.083
- D-4000: liters (or gallons) D-4000 = wt% x sump vol liters (or gallons) x 0.018
- K_2CO_3: kg K_2CO_3 = wt% x sump vol liters x 0.01 1lb. K_2CO_3 = 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.

wt% = N x ml HCl x FW / 20 x ml Sample

(N= acid normality; FW = formula weight)

FW of Na_2CO_3=106

FW of $Na_2CO_3 \cdot H_2O$= 124

FW of K2CO3 = 138

Defoamers

Riston® 200 will usually require some defoamer. The need for defoamer and the amount required are dependent on water quality, carbonate purity, photoresist loading, and equipment design. If required, add 0.8 - 1.3 ml/liter (3-5 ml/gallon) of:

- Alpha Metals (Ardrox) PC 4772 or PC4772D
- Chemelex BB

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: 1.4-2.4 bar (20-35 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:
  Na_2CO_3: 0.7-1.0 wt%; 0.85 wt% preferred
  $Na_2CO_3 \cdot H_2O$: 0.8-1.1 wt%; 1.0 wt% preferred
  K_2CO_3: 0.8-1.1 wt%; 1.0 wt% preferred
- Temperature: 27-35°C (80-95°F); 30°C (85°F) preferred

Dwell Time

- Breakpoint: 50-70% % (60 % preferred)
- Time in Developer (Dwell Time), at 2.0 bar (30 psig) spray pressure, 60% breakpoint, 30°C, fresh developer solution at recommended carbonate concentrations in a Chemcut 2000 developer:

  Riston® 215: 30-40 seconds
  Riston® 220: 40-55 seconds

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

- Time to Clean (time in developer to wash off unexposed resist):16-21 seconds for Riston® 215 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-m^2/liter (0-12 mil-ft^2/gal)

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

Rinsing & Drying Recommendations

- Rinse water: hard water preferred (140-320 ppm $CaCO_3$ equivalent), but 200 can be developed in soft water. 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: Minimum of 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 pH of solution reaches 10.2.
- Developer conveyor speed: see "**Dwell Time**".
- Feed & Bleed: to keep loading at about 0.2 mil-m^2 l (8 mil-ft^2/gal), activate addition of fresh developer at pH 10.5; stop addition when pH 10.7 is reached.

Developer Solution pH Response to Resist Loading for Riston® 200		
pH	Loading (mil-m^2/lt)	Loading (mil-ft^2/gal)
10.97	0	0
10.81	0.05	2
10.67	0.10	4
10.48	0.20	8
10.33	0.30	12

Hold Time after Development before
0-5 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 buildup can be minimized by the use of anti-foam.

PART 6: Plating

(acid copper sulfate; tin/lead, tin; nickel; gold)
(Follow plating vendors' recommendations)

Preplate Cleaning

- **Preplate Cleaning Process Sequence**
  - Acid Cleaner : 40-55°C (105-130°F); 2-3 minutes
  - Spray Rinse: 1-2 minutes
  - Microetch to remove 0.15-0.26 µm (5-10 µ") copper (time: as required)
  - Spray Rinse: 1-2 minutes
  - Sulfuric acid (5-10 vol%) dip; 1-2 minutes
  - (Optional: spray rinse; 1-2 minutes)

- **Recommended Acid Hot Soak Cleaners**

Note test results, e.g.:
MacDermid Metex 9268: 10 vol%;38- 50°C (100-120°F); 3 - 5 min
***Note*:** Other cleaners may perform equally well but have not been tested.

• Rinse
- Two-stage, counterflow
- Flow: sufficient to prevent color, foam, solids buildup
- Rinse temperature: 15-25°C (60-80°F); preferred range: 20-25°C (70-80°F)
- Rinse time: • 1 minute

Microetch
• Etch Depth: 0.15-0.26 µm (5-10 µ") of copper
- Sodium or ammonium persulfate & 1% H_2SO_4 at 20-25°C (68-77°F)

Control Test:

- Check etch rate by weight loss with coupon. Prepare coupons in the same manner as production panels (e.g. antitarnish treatment of electroless copper, Riston® 200 lamination, development, preplate clean; use realistic hold times).

PART 7: Etching

- Riston® 200 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.
- Riston® 200 series resist are compatible with alkaline ammonical etchants (pH < 9.5).

During alkaline etching, the replenisher flood rinse should be well vented (flow toward etch chamber) to minimize ammonia vapors that may attack the resist.

PART 8: Stripping

Aqueous Caustic (NaOH or KOH) Conveyorized Stripping
***Note*:**

- Dwell Time = 2x Time to strip resist
- High caustic concentrations produce larger skin sizes and higher loading capabilities.

Stripper Dwell Times (seconds) at 55°C (130°F), 1.7 kg/cm^2 (25psig), Over Recommended Exposure Range		
	215	220
1.5 wt% NaOH	80 -110 sec	150 -190 sec
3.0 wt% NaOH	60 - 80	100 -120
1.5 wt% KOH	110 -140	120 -170
3.0 wt% KOH	50 -70	90-110

- KOH generally produces smaller skin sizes than NaOH.

  Particle Size at 1.5% NaOH: 2-4 mm
  Particle Size at 3.0% NaOH: 3-10 mm
  Particle Size at 1.5% KOH: 1-3 mm
  Particle Size at 3% KOH: 2-10 mm
- Solubility of Stripped Particles: TBD
- Rate of dissolution of Stripped Particles: TBD

- 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 8 days exposure is not unusual.
- Higher levels of exposure increase Time-to-Strip:

Defoamers

Additives for foam control may not be required depending on equipment design and operation.

Riston® 200 Riston® Step 10-18	% TTS Increase
3% KOH/NaOH	0 - 10%
1.5% KOH/NaOH	15 - 40%

Controls/ Solution Maintenance:

- Preferred: Continuous replenishment (feed & bleed) using board count.
  Maintain resist loading at ≤ 0.4 mil-m^2/liter (≤15 mil-square feet/ gallon), for caustic strippers
- Batch: up to 0.5 mil-m^2/liter (20 mil-square feet/ gallon). Maintain breakpoint at ≤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 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.

The following proprietary strippers have been used successfully:
Alpha Metals (Adrox) PC4069
Atotech BC 925F
Dexter RS 1609
Atotech RR3

Other strippers may perform equally well but have not been tested.

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

Storage

See recommendations in the General Processing Guide (DS98-41)

Waste Disposal

For questions concerning disposal of photoresist waste refer to the latest DuPont literature and Federal, State, and Local Regulations.

Safe Handling

Consult the Material Safety Data Sheet (MSDS) for Riston® dry film photoresist vapors. The vapor MSDS for this film was prepared using the highest lamination roll temperature recommended for use. If you choose to exceed this temperature, be aware that the amount of vapor may increase and that the identity of the materials vaporized may vary from those in the MSDS. For more Safe Handling information, see publication TB-9944 “Handling Procedure for DuPont Photopolymer Films”.

For further information, please contact your local representative.

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