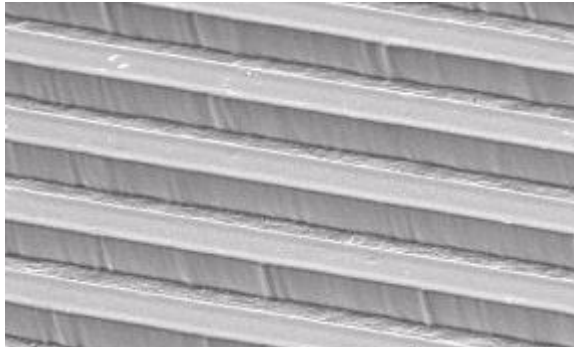


# DuPont™ Riston® TentMaster TM200i Series

## DATA SHEET & PROCESSING INFORMATION

Photopolymer Dry Film for Tent/Etch, Print/Etch Applications



### Product Features/ Applications

- Negative working, aqueous processable dry film photoresist
- Specially formulated for tent-and-etch applications.
- Suitable for print-and-etch application with acid etching.
- Fine Line capability with wider processing latitude and reduced sensitivity to off-contact.
- Wide processing latitude.
- Ideally suited for use on thin core laminate and flexible substrates too.

### Product Description (Physical Parameters)

Available Thicknesses:	30 microns 38 microns
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

### Quality Certification DuPont's Quality System is ISO Approved

All Riston® products are produced under the most stringent manufacturing conditions. They have been thoroughly tested by DuPont during production and are certified as conforming to the relevant production standards applicable at the time of manufacture. As DuPont's photopolymer manufacturing facilities are ISO 9001 approved, additional certification of product quality should not be necessary. However, should you require certification please contact your local DuPont representative.



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## PART 1: Copper Surfaces and Surface Preparation

### Vendor Copper (Print & Etch) Scrubbed Copper Surfaces

#### Brush Pumice:

3F or 4F grade, fused, 15-20 % v/v, 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) final rinse (pH 6-8); hot air dry.

#### Jet or Brush Aluminum Oxide (Al<sub>2</sub>O<sub>3</sub>):

Follow vendor recommendations.

#### Compressed Pad Brushing:

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

#### Bristle Brushing

500 grit; 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. Acidification of the pumice slurry with sulfuric or citric acid can prevent the slurry from becoming alkaline with time.

#### Control Tests:

- Water Break Test: >30 seconds
- R<sub>a</sub>: 0.10-0.30 μm R<sub>z</sub>: 2-3 μm

To remove vendor applied antitamish 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.

#### Chemically Cleaned Vendor Copper

Alkaline Spray Cleaner for removal of organic contaminants followed by a spray microetchant for removal of chromate conversion coating and/or copper oxide (about 1.0 μm minimum copper removal). To remove residual salts after micro-etching 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 antitamish treatment after chemical preclean to preserve the cleaned surface.

**Note:** It may be difficult to obtain surface roughness on very smooth panel plated surfaces by chemically cleaning alone.

#### 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 30 microinches of copper. Following a second rinse an antitamish 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: 115°C ± 5°C (230 ± 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\*

- Waterflow rate, each 5-15 ml/min. valve (Yieldmaster® models only)

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

The lamination conditions recommended here will provide good resist conformation and adhesion to clean copper surfaces, but there is no single set of conditions which is optimum for every process. Hence, these conditions should be considered only as a starting point for process optimization.

**On rougher laminate or with marginally-prepared surfaces, yield can often be increased by laminating at higher roll temperatures.** However, one must be cautious for several reasons. All resists emit vapors during lamination, and vapors increase at higher temperature. While higher temperature usually benefits yield in a tent and etch process, it should not be used without adequate ventilation, since high vapor levels can pose a potential health hazard. Also, higher roll temperature may cause wrinkles and can adversely affect tenting performance on larger holes. So, if you raise roll temperature above that recommended here, don't forget to consider these effects.

### Laminator 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.: 115 ± 5°C (230 ± 9°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:** 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 not exceed 13 mm (1/2 inch). For panels with thin photoresist and fine circuitry reduce stack height further. Individual racking of tent and etch panels is highly recommended.

### Performance on Flexible Substrates

Riston® TentMaster TM200i is also ideally suited for use on thin core laminate and flexible substrates.

## PART 3: Tenting

Riston® TentMaster TM200i Series has been formulated to provide excellent tenting performance in tent-and-etch applications.

The following table shows the tenting performance obtained over 6 mm holes with multiple passes through processing equipment:

TM215i	
• Hole Size:	6 mm (250 mils)
• % Failure Rate after 3 passes through developer:	0%
• % Failure Rate after 2 passes through developer and etcher:	0%

## PART 4: Exposure

### Resolution

The resolution data given here represent the smallest lines and spaces obtainable in a production environment, with acceptable yields attained on full size panels with Riston® TentMaster TM-200i Series photoresist. They do not necessarily represent the finest space which can be resolved nor the finest resist line remaining intact after image development.

- In Optimized Production Environment (hard contact, high intensity exposure, good development and rinse control): 50 micron L/S
- In Lab Environment: 30 micron L/S

### Exposure Intensity

- $\geq 5$  mW/cm<sup>2</sup> at the photoresist surface for 8-10 mil L/S resolution; higher intensities are desirable for finer L/S.

Exposure Energy Vs "Steps Held"	
Riston	TM200i
RST	6-18
SST	6-10
mJ/cm <sup>2</sup>	35-140

- Exposure energy (mJ/cm<sup>2</sup>) from International Light Radiometer model ZL400A with super slim UV probe.
- Steps held can vary by  $\pm 1$  RST depending on the development breakpoint used.
- If panels are exposed when warm, there may be a slight increase in the steps held.
- RST = DuPont Riston® 25-Step Density tablet;
- SST = Stouffer 21-Step Density Guide;
- "Step Held" = last step covered >50% with photoresist.

### Vacuum Frame Operation

- Preferred Contact Mode: 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 (with Mylar®/Glass exposure frames).
- Bleeder Vein thickness: Same as panel

## PART 5: Development

### Chemistries/Make-up

- **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%. For 380 liters solution use 6.8 liters of D-4000 or 3.8 kg. of anhydrous potassium carbonate.
- **Sodium carbonate, anhydrous, ( soda ash),  $Na_2CO_3$**   
Working solution: 0.85 wt%. Use 0.0085 kg/liter
- **Sodium carbonate, monohydrate;  $Na_2CO_3 \cdot H_2O$**   
Working solution: 1.00 wt%. Use 0.01 kg/liters

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

- 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 lb.  
                           $K_2CO_3$  = wt % x sump vol gallons x 0.083
- $Na_2CO_3$ :       kg  $Na_2CO_3$  = wt% x sump vol liters x 0.01 lb.  
                           $Na_2CO_3$  = wt% x sump vol gallons x 0.083

### Control Test

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

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

(N= acid normality; FW = formula weight)  
FW of  $Na_2CO_3$  = 106  
FW of  $Na_2CO_3 \cdot H_2O$  = 124  
FW of  $K_2CO_3$  = 138

### Defoamers

Riston® TM200i has been successfully used without defoamer but this is highly equipment dependent. The need for defoamer and the amount required are dependent on water quality, carbonate purity, photoresist loading, and equipment design. If required, add 1.3 ml/liter (5 ml/gallon) of BASF's Pluronic 31R1, or equivalent polyethylene-polypropylene glycol block copolymer.

- 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.
- Any excessive foaming that may be noticed below operating temperature should subside upon heating.

### Development Conditions

- Spray Pressure: 1.5 - 1.8 bar (22-25 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  
 $K_2CO_3$ :           0.75 -1.0 wt%; 0.9 wt% preferred

**Note:** The use of buffered development solutions, containing KOH (Potassium Hydroxide) or NaOH (Sodium Hydroxide), is not recommended with DuPont Riston® Photoresists. These solutions can lead to excessive foaming and high dissolved photoresist loading, compromising sidewall quality and photoresist resolution. Also, use of buffered chemistries can increase residue build-up in the developer, resulting in increased weekly equipment clean-out costs.

- Temperature: 27-35°C (80-95°F); 85°F preferred

### Dwell Time

- Breakpoint: 50-70%(60% preferred)
- Time in Developer (Dwell Time), at 1.5 - 1.8 bar (22-25 psig) spray pressure, 60% breakpoint, 30°C, fresh developer solution at recommended carbonate concentrations in a Chemcut 2000 developer:

Riston® TM213i: 26 - 34 seconds

Riston® TM215i: 35 - 40 seconds

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

- Time to Clean (time in developer to wash off unexposed resist):  
16 seconds for Riston® TM213i  
23 seconds for Riston® TM215i  
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: reduce soda ash concentration to as low as 0.6wt%. Do not lower temperature or spray pressure below recommended levels.

### Resist Loading

- Resist Loading: 2-12 mil-ft<sup>2</sup>/gal  
(0.05 -0.30 mil-m<sup>2</sup>/ft.)

**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  $CaCO_3$  equivalent). Softer water can be hardened by the addition of calcium chloride or magnesium sulfate. A first rinse may be followed by a dilute acid rinse, followed by a water rinse.
- Rinse temperature: 20-25°C (68-77°F)
- Rinse spray pressure: 1.7-2.4 bar (25-35 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.

### 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 a range of about 8 mil-ft<sup>2</sup>/gal, activate addition of fresh developer at pH 10.5; stop addition when pH 10.7 is reached.

Hold Time after Development before Etching  
0-5 days

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

### Developer Residues

TM200i is a very clean-developing film which leaves almost no residues. However, partial polymerization of resist can generate developer residues which in turn cause copper spots in etching. Partial light blockage in exposure frames by registration tooling, etc., can be a serious problem in both manual and automated exposure units, and must be avoided. Ideally, all exposed resist should be the same color, with good definition after development. Color fade in certain places after development indicates partial exposure from light blockage, which can cause developer residue and copper spots. For a print and etch process, this can usually be prevented by modifying artwork designs or by installing physical barriers to completely block light at problem locations.

### 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.

## PART 6: Etching

Riston® TM200i resist is compatible with most acid etchants, e.g. cupric chloride (free HCl normality  $\leq 3.0$  N),  $H_2O_2/H_2SO_4$ , and ferric chloride.

## PART 7: Stripping

### Aqueous Caustic (NaOH or KOH) Conveyorized Stripping

- Stripper Dwell Times (seconds) at 55°C (130°F), 25psig (1.7 kg/cm<sup>2</sup>), over recommended exposure range

Stripping Dwell Times		
	Tm213i	TM215i
1.5 wt% (15 g/l) NaOH	-	100
3.0 wt% (30 g/l) NaOH	57	70
1.5 wt% (15 g/l) KOH	-	140
3.0 wt% (30 g/l) KOH	-	70

### Note:

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

Particle Size at 1.5% NaOH: 5-10mm  
Particle Size at 3.0% NaOH: Sheet  
Particle Size at KOH: 2-4mm

- Solubility of Stripped Particles: Nearly Insoluble
- Rate of dissolution of Stripped Particles: Very Slow
- Physical Characteristics of Stripped Particles: 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 8 days exposure is not unusual.
- Higher levels of exposure may slightly increase Time-to-Strip.

For example, with Riston® TM200i Series the dwell time increases 20% from RST of 18 compared to RST of 10.

### Defoamers

Additives for foam control may not be required depending on equipment design and operation. However, if defoamer is needed, use 2ml/gallon (0.5 ml/ liter) for resist loadings up to 25 mil-ft<sup>2</sup>/gal (0.6 mil-m<sup>2</sup>/liter).

### Controls/ Solution Maintenance:

- Preferred: Continuous replenishment (feed & bleed) using board count. Maintain resist loading at - 20 mil-square feet/ gallon (0.5 mil-m<sup>2</sup>/liter)
- Batch: up to 25 mil-square feet/ gallon (0.6 mil-m<sup>2</sup>/liter). 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 cause copper oxidation.

### Filtration Systems

TM200i Series film is formulated to obtain relatively insoluble skins in stripping. This can extend stripping solution life greatly. However, in machines which do not have automatic skin removal, filter baskets must be emptied more frequently to prevent filter "blinding".

For TM200i, and other non-dissolving resists, it is a practical necessity that spray stripping equipment contain a filtration system to collect and remove resist skins to avoid nozzle clogging, to extend stripper life, and to keep resist skins out of 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. Basket or screen filters collect resist skins but leave them in contact with the solution until they are dumped. Cyclone or drum filters remove skins from the stripper solution continuously and automatically.

### Equipment Cleaning

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

Can be used for higher strip speed, higher resist loading, or to reduce copper oxidation, e.g. to facilitate AOI. The following strippers have been successfully used with TM200i:

- Alphametals PC-4077
- Dexter RS 1677
- RBP Chemalex Dual Strip BAT

### Storage & Safe Lighting

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

### 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 Technical Bulletin TB-9944 , "Handling Procedure for DuPont Photopolymer Films".

### Waste Disposal

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

For further information, please contact your local representative.

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