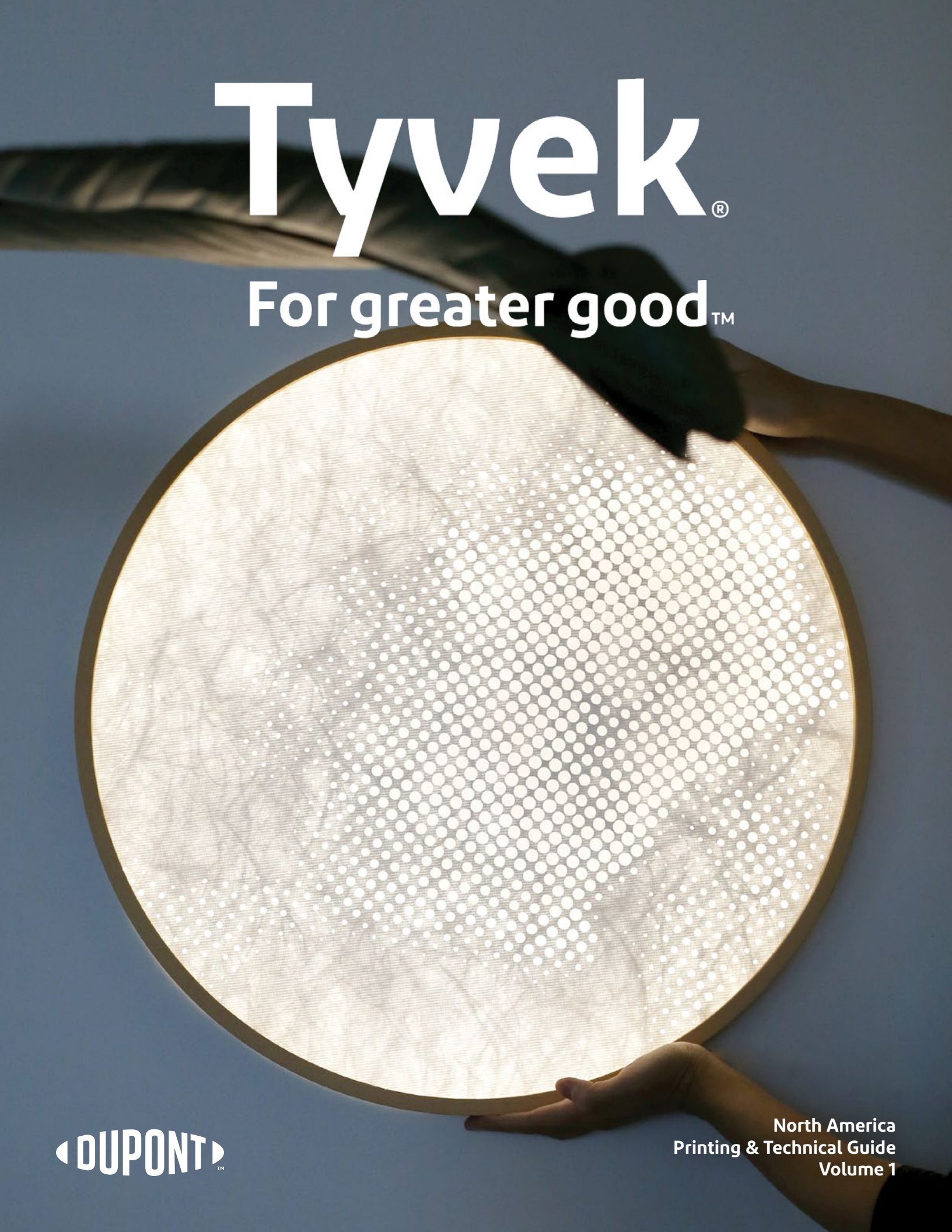
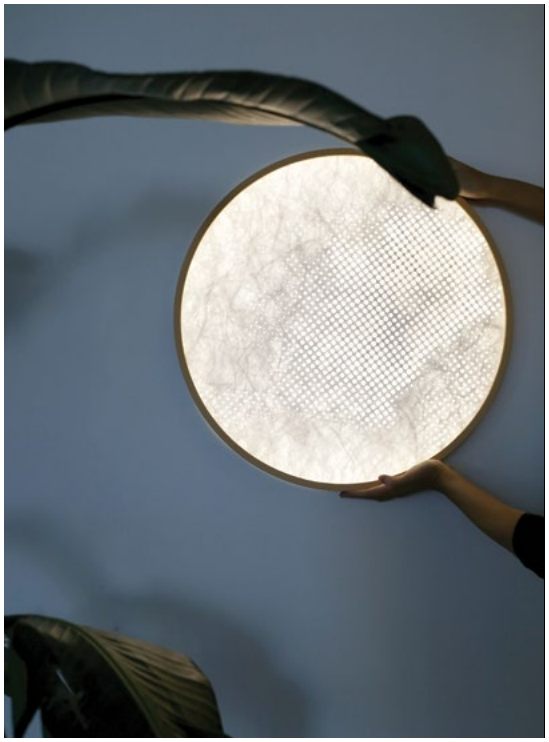


DUPONT™

North America
Printing & Technical Guide
Volume 1



Product spotlight

MOON

From in-home décor to industrial design, light fixtures made with Tyvek® work within a wide variety of spaces. The light diffusive property of Tyvek® adds simplistic refinement to minimalist design. Laser cutting processes can also be applied to create unique patterns, like the ethereal glow of this piece, created for a 2017 design contest in China.

For more ideas and inspiration on designing with Tyvek®, visit instagram.com/tyvekdesign

1

Product overview

1.1. Introduction

What is Tyvek®?

DuPont™ Tyvek® is a family of tough, durable sheet products made from high-density polyethylene (HDPE). Continuous, fine, HDPE fibers are spun into a sheet, then bonded with heat and pressure to interconnect the fibers. Depending on the bonding process, Tyvek® is paper-like (hard structure) or textile-like (soft structure).

Why Tyvek®?

The unique fiber structure and chemistry of Tyvek® provides a unique balance of properties:

- high opacity
- toughness
- outstanding resistance to microbial penetration
- barrier to particles
- gas and moisture vapor permeability
- excellent chemical resistance
- low-linting
- more resistant to abrasion than many fabrics

These unique properties make Tyvek® ideal not only for creating solutions to practical problems, but also for bringing your creative ideas to life. Fold it, cut it, print it, perforate it, the possibilities are limitless with Tyvek®.

Should I use hard structure or soft structure?

Both hard structure and soft structure are easily printable, sewable and glueable; however, hard structure and soft structure look, feel and perform differently.

Hard structure (Type 10, identified by style numbers beginning in 10 or 41) is paper-like, smooth and stiff. Compared with soft structure, it has lower coefficient of friction, is stronger and smoother. It can also hold water and can maintain a three-dimensional shape when folded or sewn (dead-folded).

Soft structure Type 14 is soft, fabric-like and drapeable. Sewing, gluing and, to a limited extent, ultrasonic seaming and heat sealing, may be used in fabricating these styles.

Type 14 styles are used where barrier, durability and breathability are required. They offer excellent barrier against particulate matter and can provide an excellent bacterial barrier. The unique low-linting properties, combined with the barrier properties, make Type 14 an excellent material for cleanroom garments and pharmaceutical manufacturing garments.

1.2. DuPont™ Tyvek® styles

Style designations

- Style designations that end in D or R (and 1079) are antistatic and corona treated. Antistatic treatment reduces static buildup during converting. Corona treatment improves adhesion to inks, coatings and glues.
- Style designations that end in B are NOT treated. Untreated styles meet U.S. Food and Drug Administration (FDA) requirements for food contact, with some limitations.
- Type 10 and 41: Style numbers beginning with 10 or 41 are hard structure.
- Type 14: Style numbers beginning with 14 are soft structure.

1.2.1. Graphic applications

1025DR 1.25 oz/yd²
1056DR 1.60 oz/yd²
1059B 1.90 oz/yd²
8740D 2.00 oz/yd²
1073D 2.20 oz/yd²
1079 2.85 oz/yd²
1085D 3.20 oz/yd²
4173D 2.20 oz/yd²
1443R 1.25 oz/yd²

1.2.2. Tyvek® styles for self-adhesive applications

1073D 2.20 oz/yd²

1.2.3. Tyvek® for wide format

1073D 2.20 oz/yd²
1079 2.85 oz/yd²
1085D 3.20 oz/yd²
4173D 2.20 oz/yd²

1.2.4. Maps, charts and durable documents

1056DR 1.60 oz/yd²
8740D 2.00 oz/yd²
1073D 2.20 oz/yd²
1079 2.85 oz/yd²
1085D 3.20 oz/yd²
4173D 2.20 oz/yd²

1.2.5. Tyvek® styles for direct food contact U.S.A.

1025B 1.25 oz/yd²
1042C 1.25 oz/yd²
1058C 1.60 oz/yd²
1059B 1.90 oz/yd²
1073B 2.20 oz/yd²
2025B 1.42 oz/yd²
2058C 1.76 oz/yd²

1.2.6. Tyvek® Brillion® for thermal transfer printing

Tyvek® Brillion® 4173D 2.20 oz/yd²

Calendered Tyvek® style with flat smooth surface, which is designed for thermal transfer printing.

1.2.7. Graphic/clothing applications

1443R 1.25 oz/yd²

See **Table 1** for a list of end-use applications for Tyvek®.

Table 1. End-use applications for DuPont™ Tyvek® print media

For more specific information, visit the product selector tool at graphics.dupont.com/productselector.

	1025DR	1056DR	1059B	8740D	1073D	1079	1085D	Tyvek® Brillion® 4173D	1443R (Soft Structure)
Tags & Labels									
Carpet, hunting, seed bag, self-adhesive, sew-in, warning tags		•		•	★		•	•	
Food tags (FDA approved)			★						
Furniture, law, security, wire/cable tags	•	★		•	•		•	•	
Garment/textile tags	★							•	
Hangtags; plant, OEM parts, shellfish, airline tags		•		•	•	★	•		
Nursery and plant tags					•	★	•	•	
Pallet tags		•		★	•		•	•	
Ski, lumber tags						•		★	
Steel tags		•		•	•	•	★	•	
Thermal Transfer									
Barcode								★	
Wristbands									
Wristbands		•		★					
Wide Format									
Signs and banners					•	•	★	•	•
Maps and Charts									
Military and hiking maps		•		•	★	•	•		
Charts		•		•	•	•	★		
Race Bibs									
Racing numbers		★		•	•				•
General Graphics									
Archival			★						
Books, calendars, documents, CR forms, kites, measuring tape, tickets		★		•					
Forms, reinforcing tape	★								
Licenses		•		★		•	•	•	
Accessories									
Wallets, passport covers					★		•		
Umbrellas									★
Apparel									
Raincoats, jackets									★
Hats, shoes, watches						★	•		
Bags									
Soft bags & purses, grocery bags, laptop covers									•
Backpacks, bags, lunchbags						★	•		
Decorative/Specialty									
Decorations, household items, placemats, tablecloths, tents/tarps, sleeping bags, room dividers, furniture, curtains									★
Lamps, light diffusers, wallpaper, wine bags	•	•					★		

★ Recommended application

1.3. Product features

1.3.1. Aging/UV resistance

When stored in a controlled environment—air conditioned and without ultraviolet (UV) exposure—DuPont™ Tyvek® has a long shelf life. UV resistance can be improved by special printing or coating procedures. Some Tyvek® styles contain UV stabilizers that are intended to extend the service life, but even these styles can withstand no more than four to six months of UV exposure. Specification of UV service life is the responsibility of the customer because service life is dependent on the application and method of use. The customer is responsible for determining that Tyvek® is suitable for the intended application. For more information, contact DuPont at 1-800-448-9835 or contact us on our website graphics.dupont.com.

1.3.2. Chemical resistance

Tyvek® is unaffected by most acids, bases and salts. Prolonged exposure to strong oxidizing agents such as concentrated nitric acid or sodium persulfate may cause some loss of strength. Resistance to various acids and bases; oxidizing and reducing agents; salt solutions; and organic solvents is summarized in Appendices 1–5. Visit Appendices for more information.

1.3.3. Coefficient of friction

Tyvek® has a low coefficient of friction. The surface is very smooth, making it unique for packaging solutions.

1.3.4. Corona treatment

Tyvek® graphics styles are corona treated to improve ink and coating adhesion. This treatment oxidizes the surface and increases the wettability of the surface to inks, coatings and adhesives. This treatment can last more than 20 years, if properly stored. Any Tyvek® style with a D or R suffix, plus 1079, are corona treated.

1.3.5. Dimensional stability

Between 0% and 100% relative humidity, Tyvek® remains dimensionally stable. Under these conditions, dimensions change less than 0.01%.

1.3.6. U.S. FDA food contact regulations

Tyvek® styles 1059B and 1073B meet the Federal Food, Drug and Cosmetic Act (FDA) requirements of Title 21 of the United States Code of Regulations for olefin polymers (21 CFR 177.1520) and additives (21 CFR 178.2010) for food contact applications such as food packaging and desiccant, de-oxidizing agent or other protective packaging applications.

1.3.7. Flammability

The flammability characteristics of Tyvek®, a synthetic nonwoven material, are similar to those of most synthetic fibers.

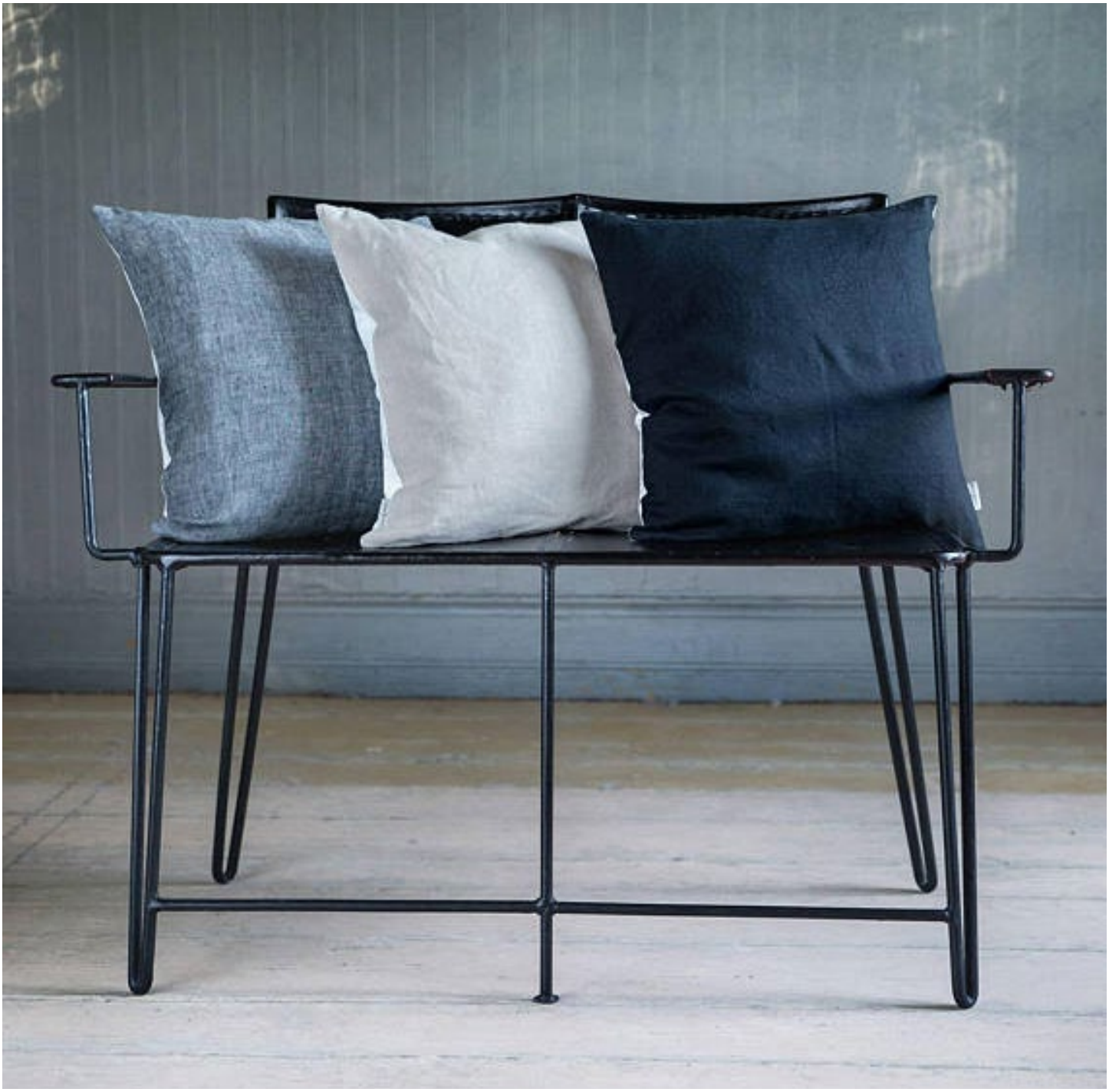
When exposed to a flame, Tyvek® shrinks away rapidly. Tyvek® will melt at 275°F (135°C) and if its auto-ignition temperature of 750°F (400°C) is reached, it will burn.

Type 10 Tyvek® is rated class “A” when tested in accordance with ASTM E-84-89a: Surface Burning Characteristics of Building Materials.

Type 14 is rated “Class 1—Normal Flammability” by the Federal Flammable Fabrics Act for Clothing Textiles (16 CFR 1610). However, garments made with Tyvek® are not flame resistant or flame retardant and should not be used around heat, flame, sparks or potentially flammable or explosive environments. Tyvek® garments will ignite and continue to burn and melt.

Tyvek® does not pass DOC FF3-71, Children’s Sleepwear Test. Tyvek® does not meet the requirements under the Federal Flammable Fabrics Act for Children’s Sleepwear, FF3-71 and FF5-74.

The user should ensure that Tyvek® meets all flammability standards for the application.



Product spotlight

TavanaStudio

These minimalist decorative pillowcases from TavanaStudio showcase the unique appearance and texture of Tyvek®. The company's Etsy-based store focuses on modern, minimalist design inspired by eco-friendly materials. TavanaStudio designs frequently combine both linen and Tyvek® to reflect the simple, bold texture combinations found within nature.

etsy.com/shop/tavanastudio

1.3.8. Flexibility
DuPont™ Tyvek® has outstanding flexural strength and exceeds 20,000 cycles when tested on an MIT flex tester (TAPPI method T-423).

1.3.9. Lightweight
Volume for volume, Tyvek® hard structure is half the weight of paper. The density of Tyvek® is 23.72 lb/ft³ (0.38 g/cm³).

1.3.10. Low-linting
Tyvek® is made of continuous fibers and under normal conditions generates far fewer airborne particles than typical paper. Some Tyvek® styles are suitable for cleanroom applications. Tyvek® is an ideal choice for packaging CDs and DVDs. DVDs packaged in Tyvek® had no parity outer failures after being challenged in shipping and drop testing. Tyvek® performance is equivalent to hard plastic in this application.

1.3.11. Safety data sheet (SDS)
The U.S. Occupational Health and Safety Administration (OSHA) classifies Tyvek® as an article under the Hazard Communication (Hazcom) Standard. Other global Hazcom regulations also consider Tyvek® an article. Tyvek® does not present a hazard as shipped or as a result of subsequent handling and use. Tyvek® does not require a Safety Data Sheet (SDS). The Article Information Sheet (AIS) of Tyvek® is available upon request.

1.3.12. High opacity
The structure of Tyvek® diffracts radiant energy very well, including visible light; this contributes to the high opacity of Tyvek®.

1.3.13. pH neutral
Tyvek® has a neutral pH (pH of 7). Therefore, it is neither acidic nor basic. Even corona and antistatic treated styles have a neutral pH. Untreated Tyvek® is ideal for storing historical documents.

1.3.14. Permeability
The moisture vapor transmission rate of Tyvek® is much higher than that of plastic and films; and is similar to that of coated papers. Compared to most textile fabrics, the air permeability of both hard and soft structure styles is low.

1.3.15. Rot and mildew resistant
Tyvek® styles without antistatic treatment will not promote the growth of mildew or other microorganisms.

1.3.16. Soiling
Tyvek® is highly resistant to soiling, but can be affected by oils and greases. Tyvek® Type 14 can be laundered. For more information, contact DuPont at 1-800-448-9835 or at graphics.dupont.com.

1.3.17. Solvent resistance
Avoid using petroleum-based and aliphatic solvents with Tyvek®—they will cause Tyvek® to distort. Water and highly polar solvents have little effect on the properties of Tyvek®. Carefully review the ingredients of inks, coatings and adhesives for compatibility with Tyvek®. A list of the preferred solvents and those to be avoided is found in Appendix 5. Solvent distortion of Tyvek® is usually reversible after the solvent evaporates from Tyvek®. However, if a vehicle or binder is present in the solvent, the distortion caused by the solvent is likely to be permanent.

Solvent distortion can be minimized by evaporating the solvent rapidly in a drying oven. For example, a sheet-fed offset lithographic ink containing 25% volatile solvent will cause severe distortion of Tyvek® 20 minutes after printing. The same ink printed on a heat-set, web offset press and dried in an oven at 200°F (93°C) will be distortion-free.

Distortion can also be caused by some plasticizers, aliphatic hydrocarbon resins used in inks, tackifiers and low-molecular-weight adhesives. The distortion caused by these materials is always permanent and, in some cases, is not apparent until several days or weeks after application.

1.3.18. Solvent compatibility testing

This is a guideline for the end user. The final testing and conditions of use are decided by the end user.

To quickly test the compatibility of inks and adhesives, place two to three drops on a sheet of the style being used. If severe distortion occurs within 20 minutes, the ink or adhesive should be avoided or used sparingly. Adhesive ingredients can cause delayed distortion of DuPont™ Tyvek® after weeks or even months of storage. This is particularly true of some solvent-based, pressure-sensitive adhesives that are transfer-coated to Tyvek® from a silicone coated release sheet.

To determine whether an adhesive is compatible with Tyvek®, we recommend a more thorough test, as follows:

1. Coat the adhesive onto a release sheet and then transfer it to an aluminum plate. Alternatively, the adhesive may be coated directly onto an aluminum plate with a doctor blade that will deposit approximately 1 mil (0.025 mm) of dry adhesive.
2. Dry the adhesive-coated plate in a lab oven at 300°F (150°C) for 10 minutes to remove all the volatile solvent from the adhesive.
3. After cooling, roll a sheet of Tyvek® onto the adhesive-coated plate. An aluminum plate is preferred for this test to eliminate dimensional changes that occur with coated release sheets.
4. After contact with the adhesive for 24 hours, place the adhesive-coated Tyvek® into a lab oven at room temperature.
5. Increase the oven temperature at the rate of 20°F/hour (10°C/hour) to a final temperature of 150°F (65°C).
6. If no distortion occurs to the Tyvek®, the pressure-sensitive adhesive is judged to be compatible with Tyvek®. However, if distortion occurs it indicates the presence of ingredients that will distort Tyvek®.

For example, low-molecular-weight polybutylacrylate is an ingredient used in some pressure-sensitive adhesives that will cause wrinkling and distortion of Tyvek® 24 to 48 hours after processing if the rolls are stored in a location where the temperatures are above 90°F (32°C). However, high-molecular-weight polybutylacrylate is compatible with Tyvek® up to 212°F (100°C). Of course, it may be necessary to screen each individual component by this procedure when testing a new formulation. This procedure has proved to be suitable for screening solvent-based, water-based, hot melt and pressure-sensitive adhesives for Tyvek®.

1.3.19. Web tension stability

High temperatures and tension on the web can cause distortion and deformation. For example, Tyvek® can withstand 1.5 lb_f/in. (2.6 N/cm) tension at room temperature. In tension, Tyvek® sheet will stretch if the web temperature exceeds 175°F (79°C); tension in excess of 0.6 lb_f/in. (1.1 N/cm) will cause permanent deformation at 225°F (107°C).

1.3.20. Static

In some converting processes, Tyvek® may generate static electricity unless treated with antistatic agents. Styles of Tyvek® with an A, D or R first-letter suffix are treated with antistatic agents. Materials with applied antistatic agents typically have maximum surface resistivity values of 6.3 X 10^9 ohm/square, as measured by ASTM D257-93 (55% relative humidity [RH], electrodes 175 $in.^2$, 0.5 inches apart on the same side of sheet).

Styles of Tyvek® with a B or C first-letter suffix do not contain an antistatic agent. Styles with no antistatic agent can build a static charge during roll or sheet handling and should not be handled in areas where the potential for explosive vapor or powder/air mixtures exists.

Laundering, clean processing or other subsequent process steps may lessen antistatic performance. Customers are advised to evaluate any materials or garments that have been exposed to laundering, secondary processing, reprocessing or that were not supplied directly to them by DuPont to verify that the properties meet their needs.

The topical antistatic agent is water soluble and is not intended as a “safety” feature. It is added to the Tyvek® used in garments to help reduce static build-up and nuisance garment cling. Tyvek® garments should *not* be used in potentially flammable or explosive environments. Additionally, for any fabric or garment to be static dissipative, it must be able to drain a charge buildup through proper grounding devices.

For antistatic treated DuPont™ Tyvek® materials, the performance of the current antistatic agent depends on relative humidity (RH) and works best at about 50% RH. Additional means for static dissipation should be considered at or below about 20% RH.

If unclear whether or not the style of Tyvek® under consideration contains an antistatic agent, please contact DuPont at 1-800-448-9835. Visit the product selector tool to learn which style is best suited for your project.

1.3.21. Strength

Tyvek® is tear resistant whether wet or dry. Due to its unique structure it remains strong even when folded. Tyvek® can be creased, dead-folded and bent almost indefinitely without losing its strength.

1.3.22. Temperature range

Toughness and flexibility are retained down to the glass transition temperature of HDPE (-100°F [-73°C]). Tyvek® begins to shrink at 185°F (85°C) and melts at 275°F (135°C). Tyvek® can withstand 1.5 lb_f/in. (2.6 N/cm) tension at room temperature. In tension, Tyvek® sheet will stretch if the web temperature exceeds 175°F (79°C); tension in excess of 0.6 lb_f/in. (1.1 N/cm) will cause permanent deformation at 225°F (107°C).

If your operating conditions fall outside these ranges, we recommend that you test the Tyvek® to determine its suitability for your particular environment.

1.3.23. Toxicity

Many representative samples of various Tyvek® styles manufactured by DuPont have been tested for skin irritation and dermal sensitization in standardized tests. The test results indicated that the Tyvek® products as manufactured by DuPont are not skin irritants or contact sensitizers.

1.3.24. Water/moisture resistance

Tyvek® is equally strong wet or dry under ordinary conditions and ambient temperature (73.4°F [23°C]). The physical properties of Tyvek® are not affected by water.

Hydrostatic head is a measure of the force required to push water through a substrate; it is a function of the surface chemistry and surface energy. The average hydrostatic head of Tyvek® B styles, (i.e., no corona or antistatic treatment) exceeds 50 in. H_2O (127 cm H_2O).

Antistatic treatment on Tyvek® reduces the average hydrostatic head by approximately 20%. If Tyvek® is both corona- and antistatic-treated, the hydrostatic head is reduced by approximately 30%.

1.3.25. Whiteness

Tyvek® is one of the brightest materials available for printing. The GE Brightness of Tyvek® is 94.1 (using the TAPPI Standard Test Method/Technidyne Instrument). For purposes of comparison, a pure titanium dioxide pellet measures 93.8. Color value, or whiteness, is also defined by L, a, b values. The following values are typical for Type 10 hard structure styles. The HunterLab Model D25 colorimeter measures brightness, color components and whiteness.

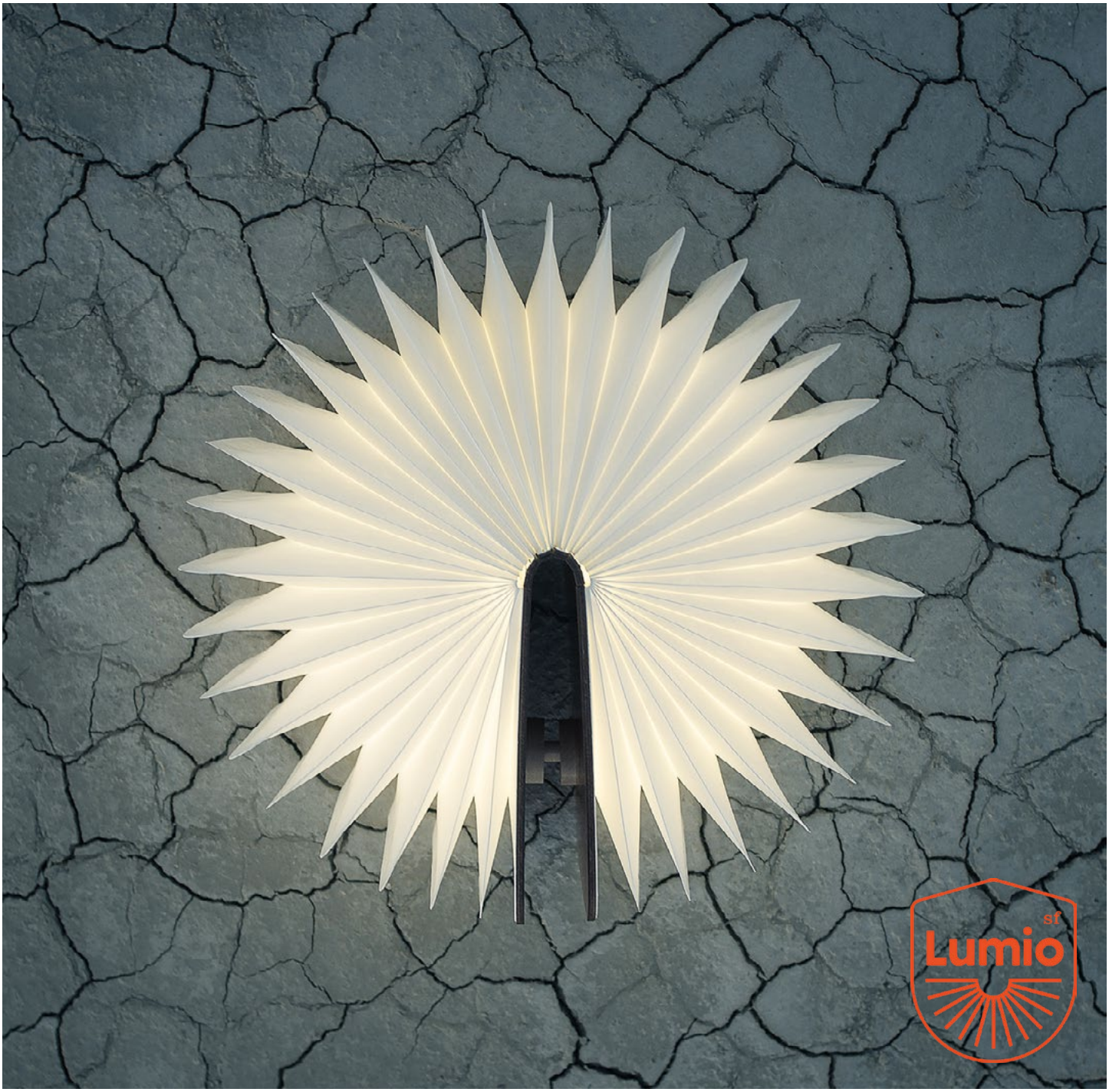
L = 97.8 brightness (100 for perfect)

a = 0.3 green component

b = 0.1 yellow component

W = 96.5 overall color acceptance

Any questions, contact DuPont at 1-800-448-9835 or at graphics.dupont.com.



Product spotlight

Lumio

A product design winner at the 2015 Red Dot Awards, this multi-functional Lumio lamp opens 360 degrees, transforming from an average looking hardcover book into a simplistic, versatile lighting solution. While bringing his architecture-inspired passion project to life, founder Max Gunawan searched for a material that could withstand repeated folding while still maintaining the right level of translucence. He found his solution in Tyvek® and the Classic Lumio was born.

hellolumio.com

2

Printing

2. Printing

DuPont™ Tyvek® is a popular printing substrate due to its light weight, smooth surface, high dimensional stability, opacity, toughness and durability. Uncoated Tyvek® can be printed using most digital and commercial printing processes. Some digital presses and some aqueous ink jet printers require a special coating. Tyvek® can be printed either sheet or web-fed. Tyvek® can be printed the same way as paper, although some of its physical properties do require special attention.

2.1. Precautions

- Tyvek® web is tough; when handled as recommended, web breaks rarely occur.
- Tyvek® is slippery and should not be used in any application where it will be walked on without the application of a slip-resistant coating.

2.2. Project planning

To achieve excellent print quality, both the designer and printer must understand the unique properties and characteristics of Tyvek®.

Longer drying time may be required

Tyvek® is not as absorbent as paper, so inks take longer to dry on Tyvek®. Allow up to two days to complete the printing process because extra drying time—up to 24 hours per side—may be needed to allow the first side to dry before printing the second side. The drying time depends on room conditions, as well as the amount and type of ink used.

Basis weight

For two-sided printing, use higher basis weight Tyvek® styles, such as 1085D.

Color and design

- Identify critical colors in the planning and design stage.
- Uncoated Tyvek® does not provide a glossy print surface.
- When specifying PANTONE® Matching System (PMS) colors, match the ink directly on Tyvek®. Test proofing on Tyvek® is the only sure way to check color matching.
- Reference PMS colors for uncoated paper (U) in the PANTONE® Color Formula Guide when selecting colors for Tyvek®.
- When using a four-color process, avoid fine reverse lines, borders and type of less than 6 point. Use a two to three dot overlap trap.
- Whenever tight register is required, the color with the least amount of ink coverage should be printed on the first station, followed by increasing amounts of ink coverage on subsequent stations.
- When a special color, such as a corporate logo color, is to be printed in a four-color process piece, it is highly recommended to print the special color as a fifth or sixth non-process (PMS) color on a six-color press. This will allow more freedom to correctly color match the four-color subject without shifting the Pantone required colors.

Temperature and tension guidelines

Tyvek® is more elastic than paper and should be handled under the lowest tension possible to avoid distortion and misregistration. The melting point of Tyvek® is 275°F (135°C). Tyvek® can withstand 1.5 lb_f/in. (2.6 N/cm) tension at room temperature. In tension, Tyvek® sheet will stretch if the web temperature exceeds 175°F (79°C); tension in excess of 0.6 lb_f/in. (1.1 N/cm) will cause permanent deformation at 225°F (107°C). Heat transfer and dye sublimation printing are not recommended because the temperatures used to transfer the dyes exceed the melting point of Tyvek®.

Fiber swirl

DuPont™ Tyvek® has an inherent fiber swirl pattern that cannot be covered up by applying more ink. Dark solids accentuate the appearance of fiber swirl, whereas small, busy patterns using light colors and screens minimize the appearance of fiber swirl. Fiber swirl can sometimes be minimized in large areas of light colors by using opaque colors (e.g., ocean blue on a map).

Gold and silver metallic inks can be printed on Tyvek®; however, due to the light scattering effect of the fiber pattern, a bright, shiny metallic effect is not achieved. Foil stamping is a better alternative. See Section 3.4., "Embossing and Foil Stamping."

Cutting

When sheeting, slitting and die cutting, knives and dies must be kept sharp because hangers will not break off like they do with paper. See Section 3, "How to Convert DuPont™ Tyvek®" for more information. Heavy edge-to-edge ink coverage and subsequent die cutting to smaller sizes may cause curling. To avoid this, leave a 1–2 cm unprinted border on all sides.

Reducing static on Tyvek® without corona treatment

Tyvek® styles for graphics are treated with an antistatic agent to reduce static during sheet handling operations; these include any style with a D or R suffix, plus 1079. Antistatic agents function best at 50% RH or more. Below 20% RH, antistatic agents lose their effectiveness and sheet feeding will become noticeably difficult. The above-mentioned styles have also been treated by corona discharge to improve adhesion of inks, coatings and adhesives. (Use static eliminator bars or equipment.) To further reduce static, use copper tinsel to connect Tyvek® to ground and install active static eliminator bars and devices such as those made by SIMCO-ION.

Ink adhesion and corona treatment

Tyvek® styles for graphics are corona treated to improve adhesion of inks, adhesives and coatings. Unlike polyethylene film and other synthetics, Tyvek® does not lose the effectiveness of corona treatment with time. If uncertain whether Tyvek® is corona treated, test the surface energy with commercially available dyne pens or perform a simple "Water Drop" Test. Corona treated Tyvek® has a surface energy of 38–42 dynes; Tyvek® without corona treatment has surface energy of about 30 dynes. Tyvek® styles with a B suffix (e.g., 1059B) are untreated and are used primarily for medical applications where optimum barrier properties are required.

Printing tips for Tyvek® having no antistatic or corona treatment

Styles of Tyvek® without corona or antistatic treatment—B styles—can be printed using standard commercial printing equipment and suitable inks; however, special steps must be taken to obtain optimum printing results. When printing on Tyvek® B styles, we recommend testing before proceeding with production operations. When processing B styles, static charge can build on the roll and discharge to equipment or people. Static may also cause cut sheets to stick together. Some end uses do not allow for special treatments (for example, sterile packaging). The end user is responsible for making sure the treatments are allowed for the specific application.

Water drop test

- Place a drop of water on the unknown sample and on known samples of Tyvek® 1059B and 1073D.
- Tilt each sheet until the drop rolls off and observe whether wetting has occurred. Water will wet out the treated style, 1073D, whereas the drop of water will remain as a ball and roll off the untreated sheet of 1059B without leaving a wet "track."

Printing on the smooth or rough side or both sides

Tyvek® is two-sided; it has a smooth side and a rough side. When printing one-sided, or where print clarity or full print coverage is most important, print on the smooth side.

On hard structure Tyvek®, the difference is minor, but can usually be felt and can be seen easily under a low-power magnifying glass. Tyvek® 1079 is cold embossed with a fine cambric pattern; as with the other hard structure styles, the smooth side is preferred for printing and coating.

Soft structure—1443R—has a linen (smooth) and a rib (rough) side. The linen side is preferred for printing because of better ink hold-out and better surface fiber stability. Garment fabrication may dictate that the rib side be printed; if so, you may sacrifice print quality slightly.

Reducing curling

To reduce curl or improve the lay-flat after printing, observe the following for DuPont™ Tyvek® hard structure styles:

- For one-sided printing, print the rough side.
- For two-sided printing, print minor coverage on the smooth side first, followed by major coverage on the rough side.
- Allow at least 0.5 in. (13 mm) unprinted border.

Note: Heavy edge-to-edge print coverage on the smooth side, followed by die-cutting into small blanks (for example, in envelopes) can result in curling. To fix, follow the recommendations above.

2.3. Printing inks for Tyvek®

We recommend using inks developed specifically for printing on HDPE or synthetic material. It is possible to use standard paper inks on Tyvek® with satisfactory results; however, this will depend on the ink formulation and ink coverage. Always do a test.

2.3.1. Ingredient compatibility

Although the properties of Tyvek® are unaffected by water, some solvents and ingredients used in commercial inks can cause swelling, distortion and/or misregistration—either immediately or after sheets have been printed. To avoid solvent distortion, all solvent-based inks must be formulated with less than 3% volatile solvents. See Appendix 5 for common solvents and their swelling effects on Tyvek®. Tyvek® may also be distorted by plasticizers and aliphatic hydrocarbon resins used in inks and in low-molecular-weight adhesives. Distortion by plasticizers and resins is generally permanent—it may appear shortly after application or weeks or even many months after application. If Tyvek® distorts within 30 minutes of printing, the ink probably contains an incompatible ingredient. Solvent distortion is often reversible after evaporation of the solvent; however, if a binder or vehicle is present in the solvent, the distortion may be permanent. Aniline dye inks are not recommended for use on Tyvek®.

2.3.2. Gloss and color matching

Ink gloss and color are important factors in achieving the desired appearance of printed Tyvek®. High gloss and darker colors accentuate the unique swirl pattern of uncoated Tyvek®. Conversely, the lower the gloss and the lighter the ink color, the less noticeable the swirl pattern.

Ink gloss on uncoated Tyvek® is difficult to achieve. Energy-curable inks, which appear brighter and more glossy, are recommended. Top coating and film lamination can be used to achieve a high gloss effect. Increasing the ink film thickness will not achieve higher gloss but will cause distortion and increase ink drying time. Press varnish does not noticeably improve gloss or ink rub resistance; however, it does accentuate the appearance of fiber swirl. In-line aqueous coating, performed on the last unit of an offset lithographic press, does not add gloss to the image. This is due to the light scattering caused by the high surface area of Tyvek®. Use coated or laminated Tyvek® when the end-use application calls for optimum ink “hold-out” high-gloss, high-fidelity printing or increased surface abrasion resistance.

Inks should be formulated using a target color swatch. Colors specified by Pantone® Matching System (PMS) colors should be formulated and matched on the specific Tyvek® style to be used. Inks made with the strongest color pigments will minimize ink film thickness and provide the best color results. When printing white on white, specify that the white be as white as possible. Alternatively, add a shadow line or border to enhance the separation.

Tyvek® is two-sided; it has a smooth side and a rough side. When color matching, the printer should specify which side of Tyvek® is being printed. If more than one side is printed, each color should be matched on the correct surface. Wet-ink densitometry measurements are needed to get the closest color match when both sides must be matched.

Because of the high surface area, Tyvek® may require up to 15% more ink than uncoated paper to achieve the same color density.

2.3.3. Color stability

DuPont™ Tyvek® should not affect the stability of printing ink pigments; however, certain pigments in offset lithographic inks can shift in color or "burn out" after printing. These pigments include Rubine Red #52, Red Lake 2C and Alkali Blue. Avoid these pigments for use on Tyvek® without preliminary testing, particularly when these pigments are used to make tints. Instead, ask your ink supplier to recommend alternatives to these pigments. The "burn out" phenomenon occurs rarely and is not predictable. High humidity and heat can add to this effect. A test for burn out can be made as follows:

- Print approximately 100 sheets with excessive fountain solution on the press and immediately seal them in plastic film.
- Compare these sheets with air-dried control sheets after 24 and then 48 hours.
- If no color shift is observed, the ink/pigment compatibility should be acceptable.

2.3.4. UV, LED and electron beam (EB) inks

UV- and LED-curable inks work well with Tyvek® and can be used for offset, flexographic, inkjet and screen printing. These inks are 100% solid systems that are instantly cured, eliminating the risk of solvent distortion and providing a means of printing high-density dark colors with improved gloss compared to conventional oxidative inks. Because of its bright blue-white surface, most press varnishes appear slightly yellow on Tyvek® and are not recommended.

Although short exposure to UV radiation has no effect on the physical properties of Tyvek®, a cooling system is recommended to keep Tyvek® cool because if Tyvek® becomes too hot it may deform. LED curing lamps are recommended over UV lamps because UV lamps can be turned up too high, generating hot spots that could distort Tyvek®.

It is difficult to achieve a high level of ink gloss and a reduction in fiber swirl on uncoated Tyvek® without first putting down a heavy base coating. However, a reasonably high level of gloss has been achieved on uncoated Tyvek® via electron beam top coating. Heavy, clear top coatings can be applied in-line with printing and instantly cured via the electron beam process.

2.3.5. Overprint varnishes

Most press varnishes appear slightly yellow on the bright blue-white surface of Tyvek® and are not recommended.

2.3.6. Recommended inks

For a list of some of the companies that have formulated satisfactory inks for printing on Tyvek®, please visit our website. Undoubtedly, there are other suppliers capable of producing satisfactory inks for use with Tyvek®.

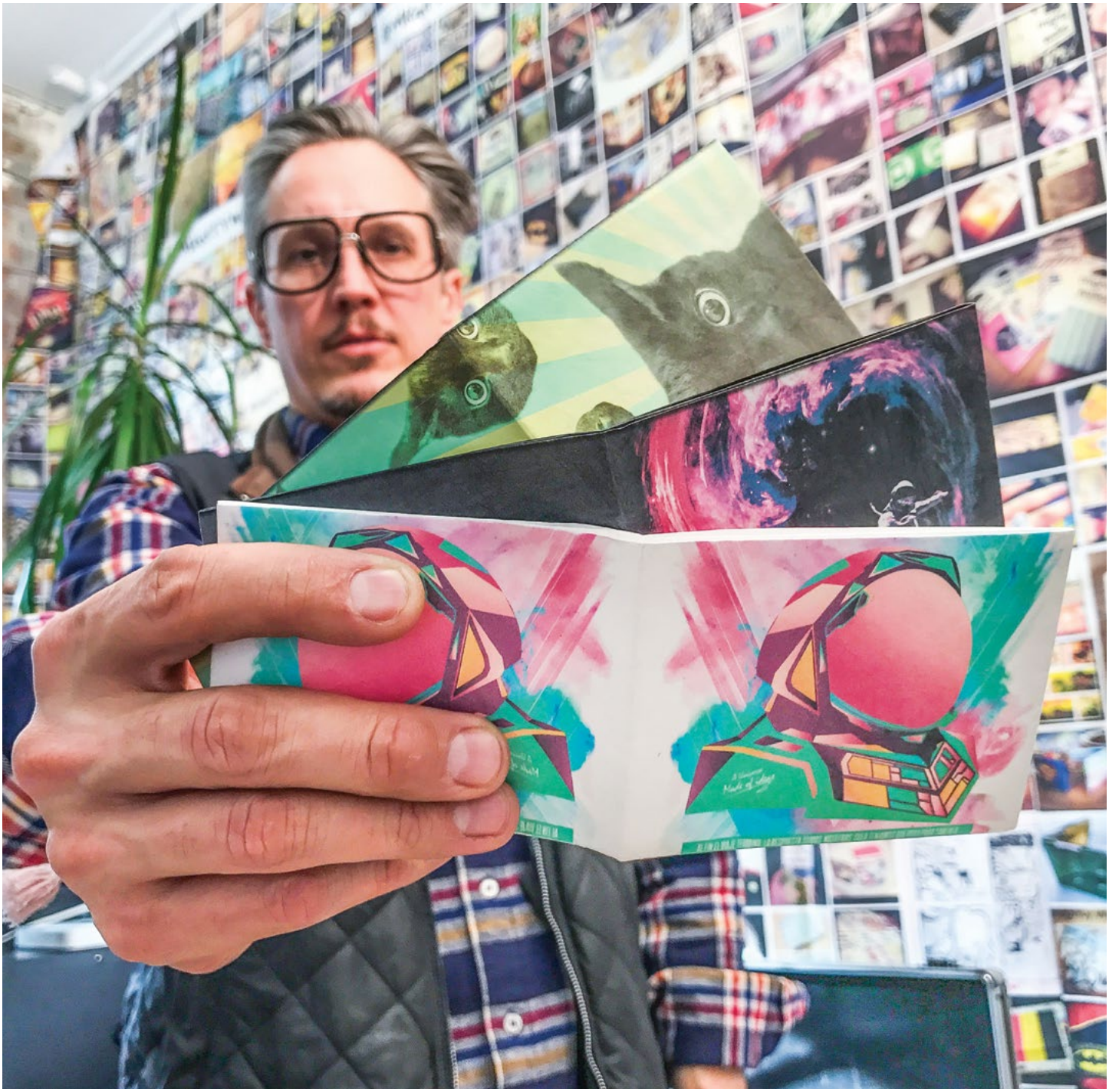
2.4. Digital printing

Tyvek® can be easily printed on web-fed digital color presses such as HP Indigo, or other presses that do not require high processing temperature. Also, the digital printers that use UV-curable inks produce excellent print quality on Tyvek®.

HP Indigo and other digital presses represent a fast and cost-effective way to produce short-run work and incorporate variable information. As on-demand printing grows and printers continue to incorporate new digital technologies into their operations, Tyvek® provides the HP Indigo printer with a solution to a wide range of strength and durability issues.

Most hard structure Tyvek® styles are compatible with digital presses. In addition, these styles are corona- and antistatic-treated; therefore, no coating is required.

- Superior strength-to-weight ratio and soft hand (race numbers, wrist tickets)
- Exposure to frequent liquid or chemical spills (drum labels, licenses)
- Protection of critical information for instruction sheets and directions (poison charts, safety guidelines, trail guides, manuals)
- Excessive handling or folding (menus, brochures, maps)
- Outdoor exposure to extreme temperatures, inclement weather, heavy wind (signage, tags)



Product spotlight

Dynomighty

The original Dynomighty Mighty Wallet was first designed by Terrence Kelleman in 2005. The widely imitated design features a stitchless silhouette achieved by utilizing an origami folding technique applied to a single sheet of Tyvek®. Dynomighty wallets are vegan, water-resistant, expandable and recyclable. The thousands of interlocking fibers inside Tyvek® give the Dynomighty wallet incredible strength inside, while the material's versatile, printable surface attracts artists from around the world to make it their canvas.

mightywallet.shop

2.4.1. Direct thermal printing
DuPont™ Tyvek® is not recommended for use with a direct thermal printer.

2.4.2. Dot matrix printing
A fade-resistant, non-bleeding ribbon is required for printing. This will allow the image to withstand a harsh environment. This is recommended because dot matrix printing is being used to imprint a variety of labels and business forms, especially those used for chemical drum labeling that require variable information, and in some cases, bar codes.

2.4.3. Inkjet printing
Tyvek® can be inkjet printed for addressing and bar coding. For optimum performance, solvent-, oil- and wax-based inks are recommended.

Selected, pigmented water-based inks can provide satisfactory performance by using special settings.

When doing high-quality graphics, an inkjet-coated Tyvek® must be used.

2.4.4. Laser printing
Conventional laser printing is not recommended on Tyvek® because of the temperatures involved in the printing units. For the same reason, Tyvek® should not be used in electrostatic copiers. However, heavier basis weight styles of Tyvek® may be compatible with laser presses having an adjustable fusing temperature. We strongly recommend working with the printer OEM to assess compatibility.

2.5. Flexographic printing

Tyvek® is printed on the flexographic press for a wide variety of applications, including: envelopes; tags and labels for commercial and industrial applications; sterile packaging; and wristbands. Flexographic equipment used for single- or multi-color web printing of flexible packaging materials is well suited to Tyvek® because it permits processing at low temperatures and tensions. Most ink suppliers have flexographic inks for Tyvek® in their product selection.

2.5.1. Inks for flexographic printing
Many different flexographic inks are suitable for Tyvek®: solvent, water-based (aqueous) and energy-curable inks. If printing food packaging or medical packaging, work with your printer and ink supplier to choose a suitable ink. Pigmented polyamide-alcohol solvent inks offer the best adhesion and rub resistance. Water-based (aqueous) inks can achieve high-quality printing while complying with environmental and contact regulations; however, drying time may be longer than with other types of inks due to the low water absorption of Tyvek®. Nitrocellulose can be added to produce a harder ink film, but with some sacrifice in adhesion.

2.5.2. Printing on Tyvek® that has not been corona treated
Ink does not adhere as well to Tyvek® styles that are not corona treated, so take these precautions to avoid offsetting and blocking during storage and heat sealing: add microcrystalline wax to inks to reduce offsetting; choose thermally resistant inks that will not block when heat-sealed; and use chill rolls at each heated station and before windup.

2.5.3. Flexographic press conditions
Ensuring optimum press conditions will help prevent web deformation, registration problems in multi-color work, adhesive softening and ink pick-off.

Web temperature
Tyvek® can withstand 1.5 lb_f/in. (2.6 N/cm) tension at room temperature. In tension, Tyvek® sheet will stretch if the web temperature exceeds 175°F (79°C); tension in excess of 0.6 lb_f/in. (1.1 N/cm) will cause permanent deformation at 225°F (107°C). To avoid oven hot spots, use high-velocity, low-temperature drying air and install diffusers to mix the air thoroughly. Gas-fired driers should be carefully controlled because high burner outlet temperatures could melt or deform Tyvek®. Install chilled backup rollers in each heating step. Also, use a chill roll prior to windup to reduce the final web temperature, which will help prevent ink blocking. Chill rolls are essential for flexographic printing on Tyvek® used for medical packaging, which is often coated with a heat seal coating on the back side. If this coating is softened, it will block and cause ink pick-off.

Web tension

Keep tension below 0.75 lb_f/in. (1.4 N/cm). A floppy web should enter and exit from the printing nip. Using powered rollers and keeping unsupported web spans short will help maintain the recommended low unwind and processing tensions. Bowed rolls ahead of printing and windup stations are effective in eliminating wrinkles and are required for printing soft structure.

Plates for flexography

There is no difference in performance between digital or analog plates. DuPont™ Cyrel® photopolymer plates produce the best overall print quality. To adjust for the inherent thickness variation of DuPont™ Tyvek®, mount plates with 15–20 mil (0.38–0.55 mm) of sticky back closed cell foam tape. Plates with thickness of 45/1.14 mm and Shore/A 75° can be used without any problem. Harder plates with thickness of 67/1.7 mm or 100/2.54 mm can be used when mounted with sticky back closed cell foam tape. Multi-color process printing is best accomplished with Cyrel® photopolymer plates with 48 lines/cm screen. The same setup requirements apply for both screen and full tone areas. The volume of ink on the anilox roll needs to be adapted to the type of Tyvek® and to the print layout. Experimentation will determine the correct amount of pressure necessary to obtain uniform ink coverage in the thinner areas without using extreme pressure.

Print on the linen (smooth) side of 1443R. To avoid dot gain in the thick areas of Tyvek®, use a screen of 85 lines/in. (33 lines/cm); with hard structure use a screen of 65 lines/in. (26 lines/cm).

2.6. Gravure printing

2.6.1. Gravure inks

Gravure inks are similar to flexographic inks. Type C nitrocellulose gravure inks are the most widely used for printing Tyvek®. They are often modified by the addition of an alkyd resin to improve ink hardness and adhesion.

2.6.2. Gravure printing techniques

Packaging materials, book coverings and apparel are often printed by gravure. Tyvek® is suitable for printing on the same type of gravure equipment used for single- or multi-color printing of paper, films and fabrics. The same techniques and precautions involved in flexographic printing should also be applied to gravure, with the following additions:

- Use gravure cylinders with 100 or more lines/in. (39 lines/cm).
- As in flexography, the web temperature should be maintained below 175°F (79°C), with tensions below 0.75 lb_f/in. (1.4 N/cm) to avoid web deformation and misregistration.

2.7. Offset lithographic printing

Offset lithographic printing produces excellent print quality on Tyvek®. Tyvek® is dimensionally stable on the offset press and handles well on both large and small, single- and multi-color offset lithographic presses.

Four-color process work should be done using a four-color press. Four-color process printing on a single-color press is not recommended because misregistration can occur due to sheet distortion between colors. When printing four or more colors that completely cover a large sheet, order the color sequence so that the color with the least coverage is laid down first and the color with the greatest amount of coverage is laid down last.

2.7.1. Inks for offset lithography

Because of its high surface area, Tyvek® requires approximately 15% more ink to achieve the same color density as on uncoated paper.

Low-solvent content inks

Low-solvent inks—less than 3% volatile solvent content—are required for offset lithographic printing of Tyvek®. Non-polar, volatile, hydrocarbon solvents that are used in some commercial inks will cause Tyvek® to distort. If Tyvek® distorts (swells, buckles or puckers) within 20 minutes after printing, the ink probably contains an incompatible solvent or some other incompatible ingredient. Tyvek® is largely unaffected by water or highly polar solvents (alcohols, glycols and esters).

UV inks
UV-curable inks produce excellent print quality on DuPont™ Tyvek® by the sheet-fed lithographic process. These inks cure instantly; do not distort Tyvek®; and offer excellent durability and abrasion resistance.

Ink formulations
Offset lithographic inks for use with Tyvek® are formulated from rosin esters and long oil alkyds; these can be diluted with drying oils, such as tung (chinawood oil) or linseed oil. 100% solid soy-based resins are also compatible with Tyvek®. Aliphatic hydrocarbon resins should be avoided because they can cause sheet distortion. High-boiling, quick-dry petroleum solvents should not be used in sheet-fed offset lithographic ink formulations. Dry pigment grinds should be used to avoid the residual solvent in pigments made from flushes. Magie® oils should be avoided. Solvent content of as-supplied resins should be checked prior to use to ensure that the volatile solvent content of the finished ink remains below the recommended 3% maximum.

Tack
If it is necessary to reduce the tack of an ink, "000" varnish, tung oil or a reducer recommended by the ink supplier should be used. Volatile ingredients, such as aliphatic hydrocarbon solvents, should not be added indiscriminately to offset lithographic inks. It is strongly recommended that ink suppliers be consulted before any attempt is made to modify ink for use with Tyvek®.

Extra-strong colors
To minimize distortion caused by the ink, apply the thinnest possible ink film and least amount of coverage. The optimum ink thickness is 0.3 mil (0.0076 mm). Tints should be made using opaque white rather than transparent extender whenever possible to minimize the amount of extender required. Using a 60% screen may reduce ink coverage significantly. Opaque ink will also reduce the appearance of the fiber swirl pattern. To achieve a thin ink film and lower coverage, use extra strong colors.

Drying
Offset/letterpress inks dry more slowly than conventional paper inks. To minimize offsetting and blocking, pile height should not exceed 20 in. (0.5 m). Winding is recommended after 6, 12 and 18 hours for sheets with heavy ink coverage. Offset powders are seldom needed, but can be used. To shorten the drying time, ink dryer can be added; contact the ink supplier for the recommended amount. It is important to note that excessive ink dryer can hinder drying and may cause distortion. Long ink drying times are usually caused by applying too much ink and using too much dampening solution, resulting in ink emulsification. Fountain stimulators used to increase the rate of drying are only marginally beneficial, but can be used if desired.

Most commercial dampening systems work well with Tyvek®; however, only enough dampening solution should be used to prevent dry-up in non-image areas. Because Tyvek® absorbs less water than paper, it requires less dampening solution. If the printed image is dull or has a washed-out appearance, the amount of dampening solution should be reduced. For optimum drying, the fountain solution should be maintained at a pH between 4 and 5.

2.7.2. Metallic lithographic inks
It is difficult to print metallic inks because the ink tends to pile on the plate and/or blanket. Aluminum (silver) looks best because the fiber swirl enhances the metallic look.

Gold is usually a two-component ink and should be mixed just before using. Two light passes will reduce the tendency to pile. Gold usually looks dull on Tyvek®. In some cases, aluminum overprinted with yellow will produce an attractive "gold" color. Wet trapping of metallic inks should be avoided when possible. An alternative would be to dry trap or reverse out the metallic color.

If Tyvek® is printed with a metallic ink and will later be glued (e.g., an envelope), the glue must be compatible with metallic inks, otherwise, the metallic effect will be lost and the color may shift. Adhesives containing acetic acid should not be used if metallic inks have been used.

2.7.3. Lithographic ink test

To determine whether a sheet-fed offset lithographic ink is acceptable for use with DuPont™ Tyvek®, the volatile solvent content should be determined. This can be done as follows:

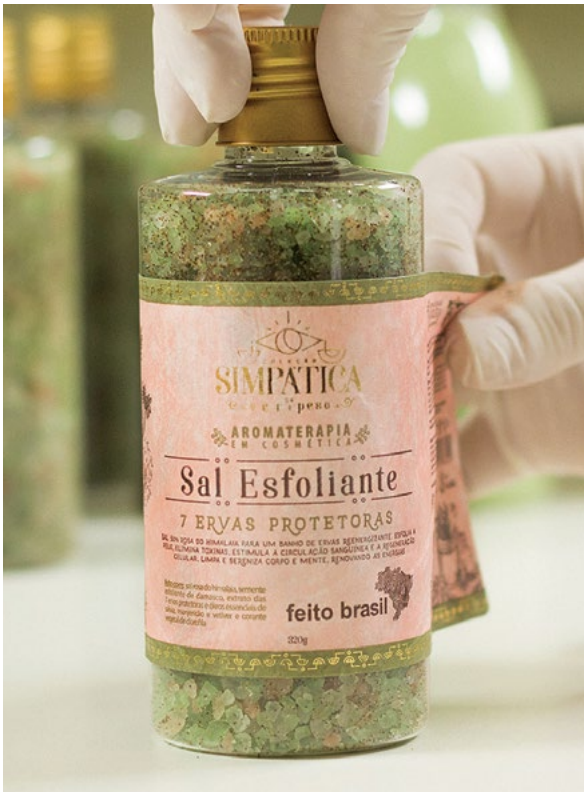
- Coat a 3 in. x 5 in. (7.6 cm x 12.7 cm) pre-weighed piece of aluminum foil with a thin film of ink—1 mil (0.025 mm) or less.
- Weigh the coated piece of foil immediately and then place it in an oven for two hours at 220°F (105°C).
- Remove from oven and allow to cool.
- Re-weigh and calculate the percentage weight loss.

Experience has shown that inks with 3% or less volatile solvents should give acceptable performance. Many quick-drying offset lithographic inks contain as much as 27% volatile solvents. These inks can cause gross misregistration and sheet distortion or curl.

2.7.4. Printing 1443R on a four-color offset press

Designers are using Tyvek® 1443R for custom apparel, bags, sports accessories and maps. Excellent graphics can be obtained on 1443R using four-color process, sheet-fed offset lithography. The advantage that Tyvek® has over other materials is that four or more colors can be printed on the smooth side while maintaining precise register and high-fidelity print quality.

- Use low-solvent (<3% volatile solvent) offset inks with as low a tack as possible, such as 14-tack.
- Use sheets 28 in. x 40 in. (71 cm x 102 cm) or smaller, which will be easier to feed and deliver than larger sheets.
- Ink pigments should be fade-resistant and detergent-resistant.
- Style 1443R has a linen (smooth) and rib (rough) side—only the linen side should be printed.
- Because of the difficulty in jogging the sheets after delivery, multi-pass printing is not recommended.
- Style 1443R can be sheeted on a fabric lay-up table or rotary knife sheeter.



Product spotlight

Feito Brasil

Feito Brasil creates artisanal cosmetics designed to empower women, respect the planet and showcase Brazilian culture. To reflect the sustainably sourced, animal friendly ingredients within their products, they have chosen Tyvek®, a recyclable nonwoven material, as the primary raw material in their labels and packaging.

feitobrasilcosmeticos.com.br

- For optimum register, feed 1443R sheets with the rib pattern parallel to the direction of travel.
- Lightweight materials, such as 1443R, are difficult to feed, so the operator must be patient while making feed adjustments.
- Reduce the air flow used to separate the sheets to a minimum. Because 1443R is lightweight, it does not require as much air.
- Do not attempt to stack or restack sheets until the ink has set.
- Do four-sided trimming near the press and use minimum clamp pressure. Load and unload the sheets with minimal handling because 1443R will not jog.
- Creases or small folds may occur in some sheets during printing due to lack of stiffness in soft structure. These creases will appear as narrow white streaks in the finished sheets. Smaller sheets are less likely to crease than larger sheets.

2.7.5. Press conditions for offset lithography

DuPont™ Tyvek® has a pH of 7 (neutral) and does not affect the chemistry of the lithographic dampening system. Because Tyvek® does not absorb water as readily as paper, the amount of dampening solution should be reduced to a minimum level to avoid a pastel or washed-out appearance of the printing (i.e., only enough dampening solution should be added to prevent dry-up in the non-image areas). It may be necessary to reduce the level several times. Reducing the dampening solution to a minimum will also prevent ink emulsification and will shorten the drying time.

Conventional offset blankets of medium hardness are recommended for offset lithographic printing of uncoated Tyvek® because they afford the best results with large, solid print areas and halftones. Compressible blankets are preferred for printing coated Tyvek® because they improve print uniformity in large halftone-screen areas, particularly when trapping screens with solids.

Tyvek® is more compressible than either film or paper; to compensate, it is necessary to add 3–4 mil (0.08–0.10 mm) of additional squeeze between the blanket and back cylinder versus paper of equivalent thickness. Excessive pressure will cause dot gain and/or misregistration. Avoid printing on Tyvek® that has been deeply and sharply embossed because it is difficult to achieve adequate ink fill without excessive pressure, which may result in sheet distortion.

2.7.6. Infrared drying and IR inks for offset lithography

Infrared (IR) drying is not recommended for offset lithographic printing of Tyvek®. IR dryers work by rapidly "flashing off" solvent under an IR unit near the delivery end of the press. Because offset inks for Tyvek® are formulated with little or no solvent, they do not respond well to IR drying. At slow running speeds that would be required to dry low-solvent inks with an IR dryer, the heat generated by the IR dryer would cause Tyvek® to shrink. Special high-solvent-content IR inks distort Tyvek®.

2.8. Screen printing

2.8.1. Inks for screen printing

A variety of screen process inks are available for printing Tyvek®. Lacquer-type inks are preferred because they produce a minimum amount of distortion. Screen "poster inks" and enamels that contain a high percentage of mineral spirits should be avoided. Water-based inks are compatible with Tyvek® because they minimize sheet distortion, even with heavy ink-film thicknesses. If Tyvek® is to be used outdoors[1]; screen inks with fade-resistant pigments should be requested from the ink supplier to avoid loss of color. UV-curable screen inks work well on Tyvek®.

2.8.2. Inks for screen printing 1443R

Screen printing Tyvek® 1443R for apparel requires an ink with optimum adhesion, flexibility and wet rub resistance. Solvent-based urethane screen inks are preferred for this type of application.

2.8.3. Solvents for screen inks

When selecting solvents to adjust the screen open or drying time, refer to Appendix 5 and choose a preferred solvent to minimize swelling and puckering. As for solvents, methyl and butyl Cellosolve® work well for adjusting screen open-time when compatible with the ink system.

1 Tyvek® graphics styles can withstand UV exposure for one to three months. The strength of Tyvek® will deteriorate with increasing exposure to UV radiation.

2.8.4. Equipment for screen printing

DuPont™ Tyvek® can be printed on hand, automatic and rotary screen presses in sheet and roll form for signs, banners and other decorative uses. When a conveyor oven with high velocity hot air is used instead of room temperature drying, the sheet temperature should be kept below 175°F (79°C) with tension below 0.75 lb_f/in. (1.3 N/cm) to avoid distortion and misregistration in multi-color web printing. When using UV-curable screen inks, cooling is required to prevent sheet distortion or shrinking due to the heat generated.

2.9. Thermal transfer printing

Tyvek® Brillion® is designed for bar code printing; however, all hard structure styles of Tyvek® are compatible with thermal transfer printing.

Both wax and wax resins can be used with Tyvek® Brillion®. Under harsh conditions or in outdoor applications, a wax/resin ribbon is recommended; also, the grease and tear resistance of the print is better with wax resins than with wax. The printhead temperature needed for printing on Tyvek® Brillion® is lower than for paper. Consult the ribbon manufacturer for the correct printhead temperature and print speed. (See Table 2.)

Table 2. Ribbon manufacturers for use with DuPont™ Tyvek®

Ribbon manufacturer	Flat head	Near edge	Notes
Armor	—	AXR-600	Armor recommends AXR-600 for near edge printers in sterile packaging applications.
DNP	TRX-55 TR4085plus	TR4500	TRX-55 is the first choice for flat head printers, then TR4085plus.
IIMAK	PM350A PM308	—	Density reading is best on PM350A.
VIDEOJET	N/A	Rough Standard (55 mm X 100 m [2.2 in. x 328 ft])	Rough Standard is specifically designed for VideoJet's DataFlex near edge industrial printers.

3

How to convert DuPont™ Tyvek®

3.1. General

DuPont™ Tyvek® is processed in much the same way as paper, plastic or films and on the same equipment. However, it does require different handling techniques for optimum results. For this reason, it is strongly recommended that those who have never worked with Tyvek® conduct a pilot run to fully test each conversion operation before beginning full-scale production.

Here are a few tips to keep in mind:

- Tyvek® will stretch up to 15%–25% before breaking. To minimize distortion or neck down during roll fed converting, keep tension less than 0.75 lb_f/in. (1.4 N/cm). This is especially important when die cutting Tyvek® business forms with rotary punched sprocket holes.
- Tyvek® is a thermoplastic material that melts sharply at 275°F (135°C).
- When coating or laminating Tyvek®, the web temperature in the oven should not exceed 175°F (79°C).
- Because of its inherent "memory," Tyvek® may occasionally curl when sheeted. Conventional decurler (breaker bar) equipment can be used at minimum tension.
- Before binding Tyvek® with printed paper, check compatibility because it may buckle or distort. Many publications contain residual solvents that can also cause distortion. When bound along the spine, paper will respond to changes in humidity. Tyvek® will not. This usually produces a buckled appearance along the spine of the publication.
- Type 10 styles with a D suffix (e.g., 1073D) and style 1079 are treated with an antistatic agent to reduce static during sheet handling operations. Antistatic agents function best at 50% RH or more. Below 20% RH, antistatic agents lose their effectiveness and sheet feeding will become noticeably difficult. These styles have also been treated by corona discharge to improve adhesion of inks, coatings and adhesives. Type 14 styles with an R suffix (e.g., 1443R) are treated in a like manner. Tyvek® styles with a B suffix (e.g., 1059B) do not contain an antistatic agent. These styles can build a static charge and should not be handled in areas where the potential for explosive vapor or powder/air mixtures exists.

For more information about the type of treatment for each style, contact DuPont at 1-800-448-9835.

3.2. Die cutting

Tyvek® can be die-cut using either steel rule, male/female or closed dies. Because the Tyvek® sheet is tough, all the fibers must be completely cut. Dies should be manufactured to close tolerances (steel rule dies are preferred) and must be in good condition with sharp, nick-free edges. Dull dies cause edges to curl. Dies should be hardened to Rockwell C50-60 to extend their life. When using closed dies, the use of a side cutter with internal relief is recommended.

Deaerate and keep lift height below 3 in. (7.2 cm) when die cutting to avoid oversizing top blanks. Die cutting lubricants should be avoided because some contain low-molecular-weight hydrocarbons that can cause swelling and distortion.

3.3. Dyeing

Conventional textile dyeing processes do not impart permanent color to Tyvek®. For this reason, Type 14 is usually printed by the flexographic or gravure process using either solvent- or water-based inks. The end user is responsible for ensuring that the dye and substrate are compatible.

3.4. Embossing and foil stamping

Tyvek® can be embossed with either high- or low-pressure equipment. Done properly, cold embossing does not significantly reduce the strength of Tyvek®; however, it does reduce opacity in the embossed area. Embossing cylinders used for Tyvek® usually are very shallow, having a depth of only 5–25 mil (0.13–0.65 mm). A Shore "D" hardness of 70 to 80 for the rubber backup cylinder is preferred. Tyvek® that is to be printed should never be deeply embossed because it is difficult to fill this deep embossing pattern with ink. Foil stamping works best on Tyvek® when it is used with type or small designs, such as corporate logos. Solid areas greater than two square inches will bubble and distort in the stamped area.

Embossing is not recommended if it is to be followed by film lamination. The depth of embossing should be adjusted so that there is only a 2 to 3 point loss in opacity.

Embossing roll temperature should not exceed 175°F (79°C) and roll tension should be kept below 0.75 lb_f/in. (1.3 N/cm). Due to the thermoplastic/elastic nature of DuPont™ Tyvek® when exposed to heat and tension, super calendering is not recommended.

Foil stamping is readily accomplished on Tyvek® due to its thermoplastic nature. A variety of foils is available from suppliers for label and bookcover applications. A foil should be chosen that will transfer cleanly and adhere to Tyvek® in a temperature/dwell time that is compatible with the melting point of Tyvek® (275°F [135°C]).

3.5. Folding

Tyvek® will take a dead fold and can be folded on conventional bindery folders. An increase in roller and spring tension will produce sharper creases. Due to the inherent slippery surface of Tyvek®, soft, rubber-covered rollers will aid feeding.

3.6. Gluing

A number of adhesives can be used to glue Tyvek®, either to itself or to other substrates. In general, water-based adhesives that provide quick tack and fast drying are preferred. However, the first step in choosing an adhesive is to determine how it will react with Tyvek®. Laboratory testing is the best way to make this determination. Appendices 3 and 5 contain a list of solvents that are preferred for use with Tyvek®.

Natural-product adhesives based on starch, dextrin or casein are preferred to synthetic-based adhesives. Water-based synthetic lattices also bond Tyvek® to itself and to a variety of substrates. Ethylene vinyl acetate (EVA) adhesives are especially useful, as are the acrylic pressure-sensitive adhesives. Synthetic adhesives often contain low-molecular-weight materials that can act as solvents at elevated temperatures, causing swelling and wrinkling. Polyurethane adhesives provide optimum adhesion (lap and shear), flexibility and water resistance for adhering Tyvek® to itself and to a variety of substrates.

Hot-melt adhesive technology has been amply demonstrated in a number of applications involving Tyvek®, including the construction of envelopes, tags and medical packaging. Care must be exercised in adhesive selection and consultation with the adhesive manufacturer is recommended.

3.7. Perforating

To make clean tearing perforations, a 10:1 cut-to-reserve ratio is recommended, the smallest land (reserve) between them. An 8:1 ratio (1/4-in. [6.4-mm] cut with 1/32-in. [0.8-mm] reserve) is suggested. Tear initiation can be ensured by positioning a cut at the edge of the sheet.

3.8. Punching

Tyvek® can be punched on tag, letterpress and rotary line-hole equipment. Best results are obtained from sharp, well-registered and close-fitting punches. Punches may be either smooth or serrated and cut best if ground concave on the ends. A soft self-honing male punch in a hardened female die is recommended. Most manufacturers of punching equipment suggest use of longer punches or deeper punch penetration, or both, to ensure a cleaner hole. A soft, self-honing male punch in a hardened female die is recommended. Gear backlash should be kept to an absolute minimum. The lowest practical tension should be used to avoid stretch and misregistration in web operations. If drilling, avoid excessive clamp pressure that can leave an impression on the sheet.

3.9. Rotary die punching

Rotary dies made of hardened tool steel or tungsten carbide are recommended for rotary punching Tyvek® because soft steel male/female rotary dies dull quickly when set to the close tolerances required to cleanly punch Tyvek®.

3.10. Laminating and coating

DuPont™ Tyvek® can be extrusion- , adhesive- , flame- , ultrasonic- and thermal-laminated. Laminates are used for protective covers, automotive parts protection, military packaging and worker protection garments. Tyvek® can be air-knife-coated or gravure-coated with heat-seal coatings for medical packaging applications.

When there is a need to improve the fidelity of printing on Tyvek® and to eliminate the appearance of fiber swirl, the best approach is to apply a coating such as that used for book covering. Tyvek® is readily coated with a wide range of solvent- and water-based materials applied with conventional equipment.

Air-knife coating is preferred for aqueous coating systems because it deposits a uniform thickness of coating on Tyvek®. It also produces a very smooth surface that is ideal for offset lithographic printing. Gravure coating has been used successfully for solvent-based coating systems, particularly where deep coloration is required. Nitrocellulose coating formulations containing a high concentration of isopropyl alcohol (25%) are preferred for obtaining deep coloration.

3.11. Heat sealing, dielectric sealing, ultrasonic sealing

Although it is possible to fuse Tyvek® to itself using only heat, it is difficult to obtain strong seals this way because melting the material destroys its fiber structure, reducing both flexibility and tear strength in the seal area. Impulse or ultrasonic sealing are preferred for sealing Tyvek® directly to itself. Ultrasonic sealing can be used to create fiber-tearing seals with most styles of Tyvek® without the puckering that is often associated with heat seals. This process also forms strong seals to a variety of plastic films and nonwovens. Styles without corona or antistatic treatment are preferred for these sealing methods.

Tyvek® styles 2025B and 2058C have a coating on one side of the sheet that improves heat seal performance on standard heat sealing equipment while maintaining permeability to gases and vapors. Coated Tyvek® styles for heat sealing are also available from our downstream converters.

Tyvek®, like polyethylene film, cannot be dielectrically sealed by conventional methods.

For more information about sealing Tyvek®, contact DuPont at 1-800-448-9835 or at graphics.dupont.com.

3.12. Sewing

Tyvek® can be sewn on conventional sewing machines. Best results are obtained with machines equipped with puller or drop-feed. Smooth, rubber covered rolls should be used rather than knurled metal rolls, which tend to leave impressions on Tyvek®. When stitching Tyvek®, the lowest possible stitches per inch (5–8 stitches/in. or 2–3 stitches/cm) at low tension and the smallest needle practical should be used. Both lock stitches and chain stitches work well, especially a 1-in. (2.5-cm) chain stitch, which can prevent raveling.

3.12.1. For Type 10 Tyvek®

- Use 3–5 stitches/in. (1.2–2 stitches/cm) at low tension to eliminate skipping.
- Use size 036 (Union Special) or 90/14 (Organ/Singer/Schmetz) needle, or equivalent.
- A flat-tipped needle that cuts slit-like perforations will permit top-speed operation with the same thread used for round-point needles.
- The informal industry standard of 25/4 tex (24/4 cc) glacé thread of short staple cotton in 90/14 and 036 needles has given satisfactory performance in outdoor banners when coupled with 16.5/3 tex (36/6 cc) soft looper thread. If smaller diameter thread is required, 14.5/4 tex (40/4 cc) glacé thread of "Sak"quality should provide satisfactory results.
- Avoid stitches at or near the edge to reduce the chance for edge-tear on banners. Pressure-sensitive adhesive tabs of Tyvek® or Mylar® polyester film wrapped around a sewn seam at each edge will further reduce the possibility of edge-tear.

3.12.2. For Type 14 DuPont™ Tyvek®

- Up to 12 stitches/in. (4.7 stitches/cm) can be used; however, 6–8 stitches/in. (2.4–3.1 stitches/cm) provides the highest seam strength (greatest resistance to postage stamp tear).
- Use a fine-tooth feed dog—12–21 teeth/in. (4.7–8.3 teeth/cm).
- Decrease presser-foot tension until the sheet just feeds through the machine without slipping. Approximately 10-lb (4.5-kg) force should be sufficient.
- Decrease bobbin tension until the bobbin just slips down the thread: 3 oz (85 g).
- Wind bobbin with thread tension set so that thread just slips through the disc: 2 oz (57 g).
- After setting bobbin tension, adjust needle tension to produce a balanced stitch.
- Conventional threads of cotton/synthetic or 100% synthetic threads of nylon or polyester can be used.
- Spun-filament polyester is stronger than cotton thread and is preferred for flame-resistant considerations.

3.13. Slitting, sheeting, cutting

Because Tyvek® fibers are very strong, each must be completely severed; hangers will not break off. Knives, dies and punches must be set to close tolerances. A sharp, slightly rounded edge gives longer service than a pointed edge for crush cutting; however, a sharp edge is preferred for other slitting methods. Tyvek®, because of its inherent "memory," may occasionally curl when sheeted. Conventional decurler (breaker bar) equipment can be used at minimum tension.

Multiple roll sheeting (four to six rolls) works well with Tyvek® and is preferred for lightweight styles (less than 2.2 oz/yd² [76.3 g/m²]).

In sheeting operations, best results are obtained by using styles of Tyvek® with a D suffix. These are treated with an antistatic agent to reduce static during sheeting. When it is necessary to sheet styles that are not antistatic treated, the use of conductive tinsel, ionized air produced by an electrostatic generator or a radiation bar will usually reduce the buildup of static to an acceptable level. Antistatic agents or aerosol sprays should not be used on styles 1059B and 1073B that will be used for packaging sterile medical products or direct food label applications.

Soft structure Type 14 can be cut much like fabric with conventional straight-knife machines. However, if knife blades get too hot, soft structure can melt and edge-fuse. To minimize cutting problems:

- Replace straight-edged blades with blades that have a wavy or serrated edge.
- Use blades coated with Teflon™ TFE fluorocarbon or lubricated with a non-staining silicone spray.
- Reduce the cutting stroke from 1.5 in. (3.8 cm) down to 1 in. (2.5 cm).
- Operate at 1,800 rpm instead of 3,600 rpm.

Product spotlight

Race bibs

Tyvek® tags and labels love a good workout. From race bibs to ski tags, manufacturers who produce printed label materials for a variety of sporting events chose Tyvek® for its strength, especially during extended wear and harsh weather conditions.

4

Storage and handling

4.1. General storage and handling

Rolls of DuPont™ Tyvek® should be stored vertically on their ends and in their shipping wrappers. Horizontal storage can cause flat spots that can lead to processing difficulties. Rolls should be handled carefully with a dolly, stevedore truck or hand truck. Avoid drops or bumps that could cause deformation. Never move a roll of Tyvek® by turning or rocking it on its end. Clamp trucks can crush cores and distort Tyvek®. Clamp pressure should be set to a maximum of 1,800–2,000 psi (12,400–13,800 Pa) gauge. Core plugs should always be in place when handling rolls.

Because of the slippery nature of Tyvek®, care must be taken when moving loaded fork trucks over bumpy floors; up and down inclines; and around sharp turns. When trucking Tyvek® over any distance in sheeted form, the use of preformed corner angles, corner edge guides and flat pallet tops is recommended. In addition, light tension on vertical and horizontal strapping can prevent shifting and edge damage to the sheets.

If rolls or sheets of Tyvek® are to be stored for several months, they should be wrapped in Tyvek® or polyethylene film. Unbleached kraft paper should not be used because it may cause yellowing of the edges and top sheets. Yellowing may also be caused by exhaust gases such as from combustion engines or heating systems. Short exposure of yellowed Tyvek® to sunlight will usually cause the color to disappear. If Tyvek® is stored outdoors, it should be protected from direct exposure to sunlight because prolonged exposure to UV light will cause deterioration of physical properties.

4.2. Energy recovery

When incinerated in excess oxygen, Tyvek® yields only H_20 and CO_2. It is an excellent fuel, yielding two or more times the energy of coal, and is equal to oil in generating heat. Incineration of HDPE does not contribute to acid rain.

4.3. Recycle/reuse

Tyvek® is made from high-density polyethylene (HDPE). For this reason, Tyvek® or products made from Tyvek® can be mechanically recycled into products such as underground cable protection piping, automotive parts, blown film, packaging cores and trays. Products made from Tyvek® that are printed, glued, welded or sewn can also be recycled, as can Tyvek® that has been extrusion coated or laminated with an item from the same polymer family. For more information about recycling Tyvek®, contact DuPont at 1-800-44-TYVEK® or 1-800-448-9835 or visit us at graphics.dupont.com

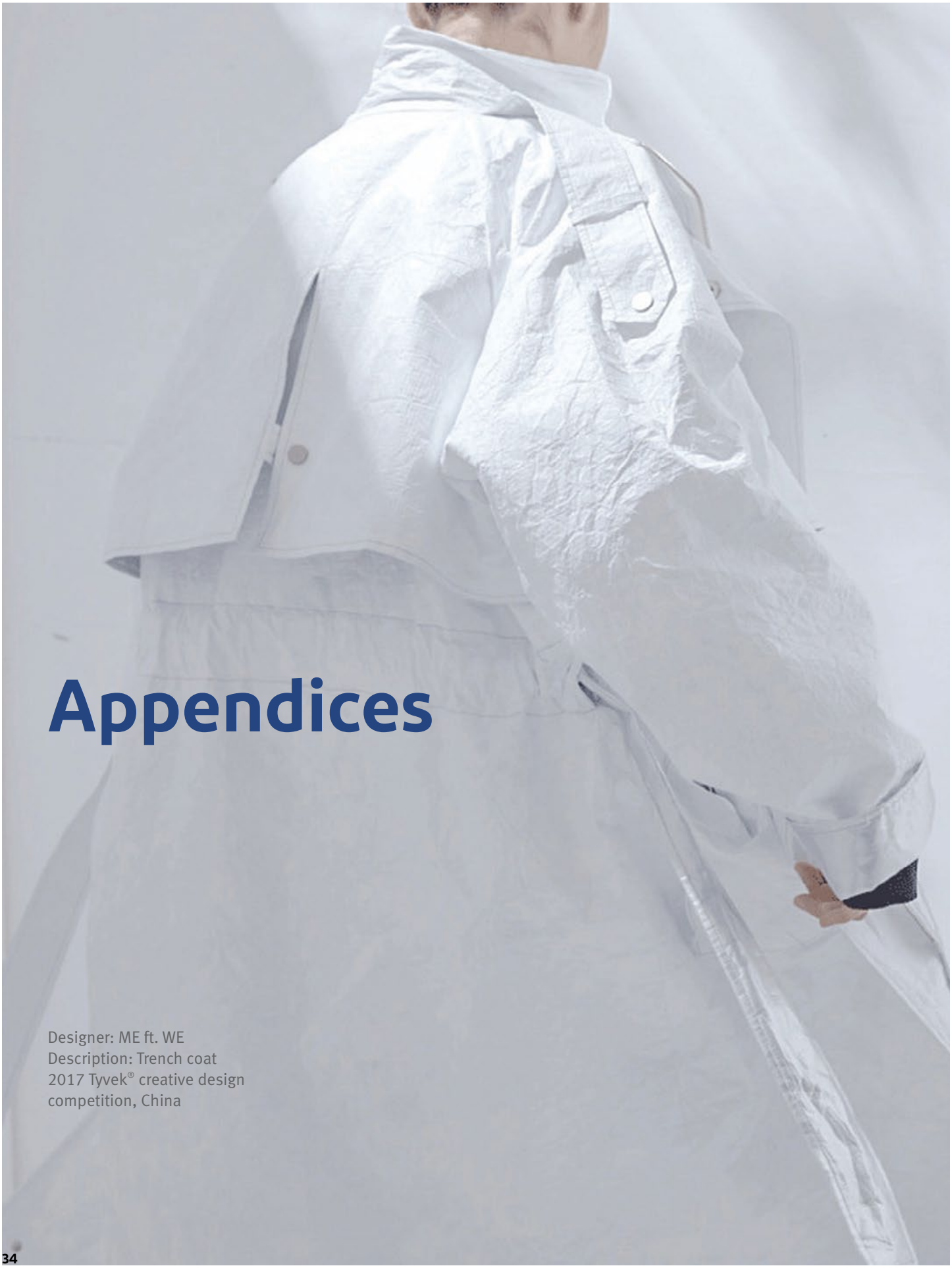
Product spotlight

Wristband Resources

Tyvek® is an ideal choice for wristbands because it is lightweight, durable and water resistant. Tyvek® also provides increased security because its strength and tear resistance mean wristbands cannot be easily transferred from one person to another without evidence of tampering or damage.

wristband.com

Appendices



Designer: ME ft. WE
Description: Trench coat
2017 Tyvek® creative design
competition, China

Appendix 1 – Resistance of DuPont™ Tyvek® to salt solutions[1]

The breaking strength of Types 10 and 14[2] is unaffected after 1,000 hours exposure at 70°F (21°C) to the saturated salt solutions listed below:

Aluminum chloride
Aluminum sulfate
Ammonium chloride
Ammonium nitrate
Ammonium sulfate
Ammonium thiocyanate
Cadmium chloride
Calcium chloride
Calcium thiocyanate
Chromic sulfate
Cobaltous sulfate
Copper chloride
Copper sulfate
Ferric ammonium sulfate[3]
Ferric chloride[3]
Ferric citrate[3]
Ferric nitrate[3]
Ferric oxalate[3]
Ferric sulfate[3]
Ferric potassium sulfate[3]
Ferrous sulfate[3]
Magnesium chloride
Manganous chloride
Mercuric chloride
Nickel chloride
Potassium chloride
Potassium thiocyanate
Silver nitrate
Sodium bisulfate
Sodium bromide
Sodium chloride
Sodium fluoride
Sodium nitrate
Sodium nitrite
Sodium sulfate
Sodium thiocyanate
Stannic chloride
Stannous bromide
Stannous chloride
Zinc chloride

1 In the case of limited use/disposable protective apparel, the user should visit safespec.dupont.com.

2 Tests actually performed on Styles 1073D and 1422A.

3 Sample yellowed after exposure.

Appendix 2 – Resistance of DuPont™ Tyvek® to oxidizing and reducing agents[1]

		Exposure conditions			Effect on breaking strength[6]
Agent	Concentration, %	Temperature, °F (°C)	Time, hrs	pH	Type 10/Type 14[7]
Calcium hypochlorite	Sat. Solution	70 (21)	1	11.8	None
Chlorine water	Sat. Solution	70 (21)	10	1.3	Moderate/slight
Hydrogen peroxide	90	70 (21)	10	—	Not tested/slight
Peracetic acid	2.0[2]	210 (99)	10	8.0	Not tested/slight
Potassium monopersulfate	1.0[3]	160 (71)	100	10.5	Moderate/considerable
Sodium chlorite	0.6[4]	210 (99)	10	4.5	None/slight
Sodium chlorite	0.6[3]	210 (99)	10	10.5	None/slight
Sodium hypochlorite	0.3[4]	70 (21)	10	4.5	Not tested/moderate
Sodium hypochlorite	5.3	70 (21)	1	12.2	None
Sodium perborate	1.0[3]	160 (71)	100	10.5	None
Sodium bisulfite	3.0[4]	210 (99)	10	4.5	None
Sodium bisulfite	3.0[3]	160 (71)	10	9.0	None
Sodium hydrosulfite	3.0[5]	160 (71)	10	13.5	None
Sodium sulfite	3.0	210 (99)	10	10.1	None
Sodium thiosulfate	3.0	210 (99)	10	9.8	None

1 In the case of limited use/disposable protective apparel, the user should visit safespec.dupont.com.

2 Sodium carbonate and 1% "Calgon" as additives.

3 Sodium carbonate as additive.

4 Acetic acid as additive.

5 Sodium hydroxide as additive.

6 Change in breaking strength caused by exposure:
None = 90% through 100% of original strength retained
Slight = 80% through 89% of original strength retained
Moderate = 60% through 79% of original strength retained
Considerable = 20% through 59% of original strength retained

7 Tests actually performed on Styles 1073D and 1422A.

Appendix 3 – Resistance of DuPont™ Tyvek® to organic solvents[1,2]

Tested at 100% concentration at 70°F (21°C) for 1,000 hours, except where noted

Organic chemical	Effect on breaking strength[3]	Organic chemical	Effect on breaking strength[3]
Acetamide[4]	None	Ether	Not tested/slight
Acetic acid	None	Ethyl acetate	None
Acetone	None	Ethyl alcohol	None
Acrylonitrile	None/slight	Ethylene glycol	None
n-Amyl acetate	None	Formaldehyde[7]	None
n-Amyl alcohol	None[5]	Formic acid[8]	Not tested/slight
Aniline	None	Gasoline (leaded)	None/slight
Benzaldehyde	None	Glycerol	None
Benzene	None	Kerosene	None/slight
Benzyl alcohol	None	Linseed oil	None/slight
Benzyl chloride	None	Methyl alcohol	Slight/none
n-Butyl alcohol	None	Methylene chloride	Slight/none
Carbon disulfide	None	Methyl ethyl ketone	None
Carbon tetrachloride	None	Mineral oil	None
Chlorobenzene, mono-	None	Nitrobenzene	Slight/none
Chloroform	None	Oleic acid	Slight
Chlorohydrin	None	Perchlorethylene	None
Coal tar	None	Phenol[4]	None
Cottonseed oil	None	Pine oil	None
m-Cresol	None/slight	Pyridine	None
Cyclohexanone	Slight/none	Tetrachloroethane	None
p-Dichlorobenzene[6]	None	Trichloroethylene	None
Dimethyl acetamide	None	Triethylamine	None
Dimethyl formamide	None	Trifluoroacetic acid	None
Dimethyl sulfoxide	None	Turpentine	None
Dioxane, 1-4	None		

1 In the case of limited use/disposable protective apparel, the user should visit safespec.dupont.com.

2 Tests actually performed on Styles 1073D and 1422A.

3 Change in breaking strength caused by exposure:
None = 90% through 100% of original strength retained
Slight = 80% through 89% of original strength retained

4 Test performed at 200°F (93°C).

5 Sample yellowed after exposure.

6 Test performed with 100% concentration of powder.

7 Test performed with 10% concentration in H_2O.

8 Test performed with 91% concentration in H_2O.

Appendix 4 – Resistance of DuPont™ Tyvek® to inorganic chemicals at 70°F (21°C)[1]

Agent	Concentration, %	Time, hrs	Effect on breaking strength[2] Type 10/Type 14[3]
Sulfuric acid	10	1,000	None
Sulfuric acid	96	1,000	None
Hydrochloric acid	37	1,000	None
Nitric acid	10	1,000	None
Nitric acid	70	10	None[4]
Phosphoric acid	10	10	None
Hydrofluoric acid	10	10	None
Ammonium hydroxide	28	1,000	None/slight
Sodium hydroxide	40	1,000	None
Chlorine water	Sat. Solution	10	Moderate
Hydrogen peroxide	90	10	Slight
Sodium hypochloride	5.3	1	None
Aluminum chloride	Saturated	1,000	None
Ammonium nitrate	Saturated	1,000	None
Ammonium sulfate	Saturated	1,000	None
Calcium chloride	Saturated	1,000	None
Copper sulfate	Saturated	1,000	None
Ferric sulfate	Saturated	1,000	None
Silver nitrate	Saturated	1,000	None
Sodium bromide	Saturated	1,000	None
Sodium chloride	Saturated	1,000	None
Zinc chloride	Saturated	1,000	None

1 In the case of limited use/disposable protective apparel, the user should visit safespec.dupont.com.

2 Change in breaking strength caused by exposure:
None = 90% through 100% of original strength retained
Slight = 80% through 89% of original strength retained
Moderate = 60% through 79% of original strength retained

3 Tests actually performed on Styles 1073D and 1422A.

4 Slight discoloration.

Appendix 5 – Order of increasing swelling effect of solvents on DuPont™ Tyvek®[1]

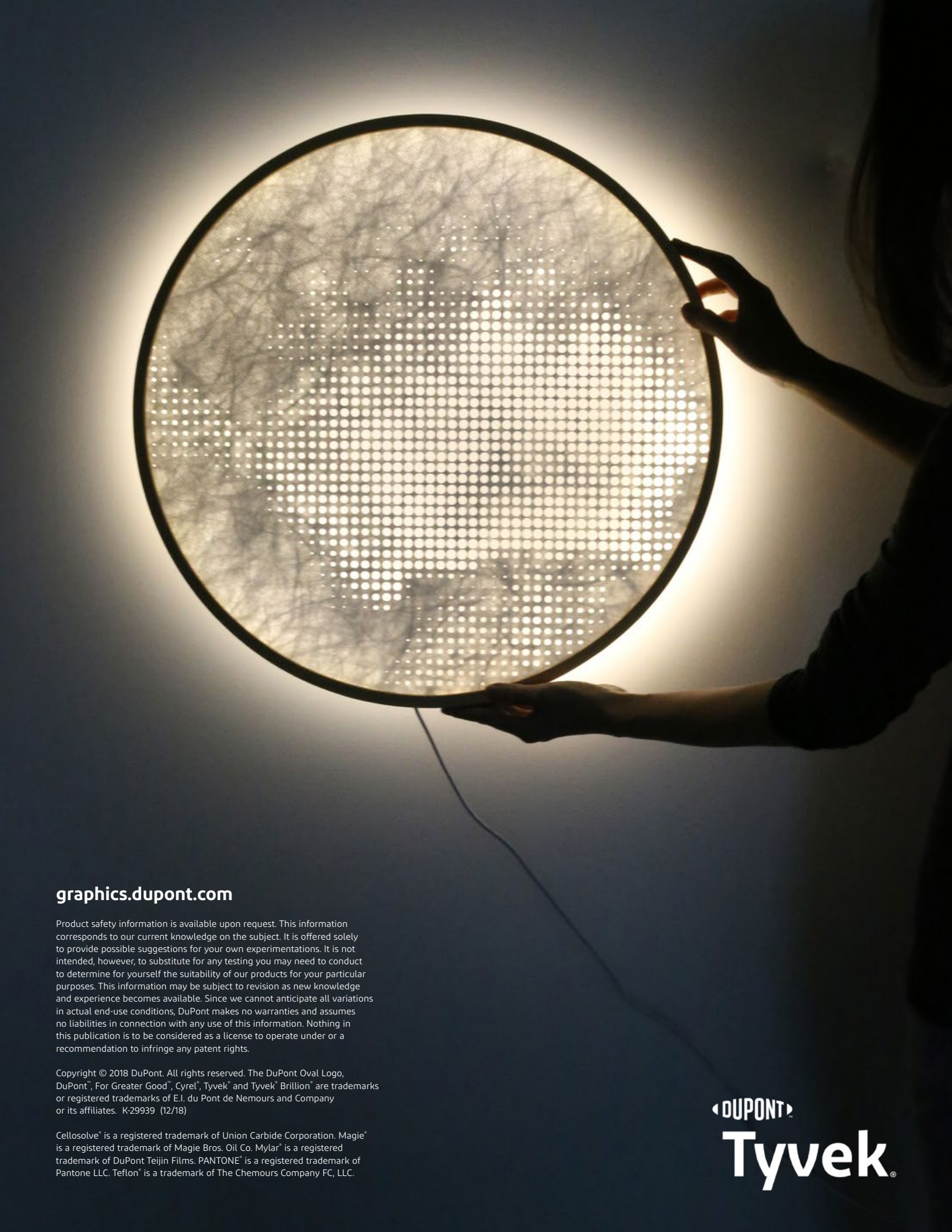
Preferred solvents	Solvents to be used sparingly	Solvents to be avoided
Glycerol	Raw linseed oil	n-Butyl acetate
Diethylene glycol	Dibutyl phthlate	Sun spirits
Propylene glycol	iso-Butyl alcohol	Pine oil
Triethylene glycol	Methyl "Cellosolve®" acetate	"Lactol"[3] spirits
Ethylene glycol	Propylene glycol methyl ether	SDW turpentine
Methyl alcohol	Acetone	Dichloromethane
Ethyl alcohol	Butyl "Cellosolve®"	Tetrahydrofuran
Diacetone alcohol	"Cellosolve®" acetate	Mineral spirits T
"Carbitol"[2]	n-Butyl alcohol	Pentane
"Carbitol" acetate	n-Propyl alcohol	Petroleum ether
Dipropylene glycol	n-Hexyl alcohol	Pinene
Methyl "Cellosolve®"[2]	n-Pentyl alcohol	Rubber solvent
Dipropylene glycol methyl ether	iso-Propyl acetate	VM + P naphtha
Methyl iso-butyl carbinol	Butyl "Cellosolve®" acetate	Toluene
"Cellosolve®"[2]	2-Octyl alcohol	Naphthol spirits
iso-Propyl alcohol	Butyl "Carbitol" acetate	Xylene
	n-Decyl alcohol	Kerosene
	Ethyl acetate	Magie® Oil[4]
	iso-Butyl acetate	
	Methyl ethyl ketone	
	n-Propyl acetate	
	Methyl iso-butyl ketone	
	Cyclohexanone	
	Diethyl ketone	

1 These data are provided as a guide for selecting solvents for inks or coatings.

2 Union Carbide Chemicals & Plastics.

3 Union Oil Co. of California.

4 Magie Bros. Oil Co.



graphics.dupont.com

Product safety information is available upon request. This information corresponds to our current knowledge on the subject. It is offered solely to provide possible suggestions for your own experimentations. It is not intended, however, to substitute for any testing you may need to conduct to determine for yourself the suitability of our products for your particular purposes. This information may be subject to revision as new knowledge and experience becomes available. Since we cannot anticipate all variations in actual end-use conditions, DuPont makes no warranties and assumes no liabilities in connection with any use of this information. Nothing in this publication is to be considered as a license to operate under or a recommendation to infringe any patent rights.

DUPONT

Tyvek®