DUPONT™ TYVEK® GRAPHICS

Technical Handbook

www.graphics.dupont.co.uk

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1. PRODUCT DESCRIPTION

1.1 WHAT IS TYVEK®?

Tyvek® is a registered trademark of DuPont for its family of tough, durable sheet products made from pure 100% high density polyethylene (HDPE). The sheet is formed first by spinning continuous strands of very fine interconnected fibres, and then bonding them together with heat and pressure.
The result is a bright white spunbonded sheet, which combines a good printing surface with high opacity, chemical resistance and toughness.

Tyvek® combines the best properties of paper, film and fabric and thus makes it ideal for a wide range of applications, in which strong resistance is needed. Depending on the bonding processes, Tyvek® is available in paper-like or textile-like styles.

Tyvek® styles

Standard styles (Type 10)
Smooth, stiff paper-like appearance, which offers excellent printability.

The following styles are currently available:

Graphics applications

1025D	42,5 g/m²
1057D	55 g/m²
1073D	75 g/m²
1082D	105 g/m²
8740D	68 g/m² For wristbands only!

Tyvek® styles for self-adhesive applications

1058D	55 g/m²
1073D	75 g/m²

Self-adhesive Tyvek® is available at many major self-adhesive coaters.
Please contact us for further details.

Tyvek® styles for direct food contact

1025B	42.5 g/m²
1051B	65 g/m²
1071B	75 g/m²

Styles with the suffix "D" or "R" have had an antistatic coating applied on both sides which aids conversion and reduce the build-up of static electricity during sheet and roll handling operation.
They have also been corona treated on both sides, thereby making them more receptive to ink and glue.
Styles with the suffix 'B' have no antistatic nor corona treatment and are therefore certified for direct food contact and toy safety.

Coloured Tyvek®
Please contact us for further details.

Tyvek Brillion®

4158D	55 g/m² for self-adhesive applications only
4173D	75 g/m² for graphic and self-adhesive applications

Calendered Tyvek® style with smooth surface, which is specially suitable for barcode printing on thermal transfer printing.

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Textile styles (Type 14)

1442R	43 g/m²
1473R	75 g/m²

Tyvek® for Inkjet printing

Available from different coaters, please contact us for further details.

Tyvek® flame retardant Inkjet

Available from different coaters, please contact us for further details.

Availability

Tyvek® is available in a wide range of rolls and formats.
(Roll width max. 3m)
Please contact us for further details.

1.2 PRODUCT FEATURES

Strength

Tyvek® is tear resistant whether wet or dry. Due to its unique structure it remains strong even when nicked and folded.

Water resistance

Physical properties of Tyvek® are not affected by water.

Chemical resistance

Tyvek® is unaffected by most acids, bases and salts. Prolonged exposure to oxidising agents such as concentrated nitric acid or sodium persulphate may cause some loss of strength.

Abrasion resistance

Through corona treatment, the surface is oxidised from both sides and the inks (as well as glues or coatings) adhere better. The fibre structure of Tyvek® allows inks to penetrate and therefore increases the abrasion resistance of the print.

High opacity

The high opacity of Tyvek® is a result of multiple light refraction between the fine fibres and air within the sheet.

Dimensional stability

Between 0 and 100% relative humidity, Tyvek® remains dimensionally stable. Under these circumstances, dimensions change less than 0,01%.

Low linting

Tyvek® is made of continuous fibres and under normal conditions produces no free lint particles. It is therefore suitable for cleanroom use.

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Lightweight
The weight of Tyvek® is less than half of that of other materials for similar strength. The density of Tyvek® is 0,38 g/cm³.

Rot and mildew resistant
Tyvek® does not degrade after being buried in soil for an extended period. Clean Tyvek® will not promote the formation of mildew or other micro-organisms.

Temperature range
Tyvek® retains its toughness and flexibility to -75°C. Tyvek® begins to shrink at 118°C and melts at 135°C.
When processing Tyvek® web under tension, the temperature should not exceed 80°C.

High flex strength
Tyvek® can be creased and bent almost indefinitely without losing its strength.

Flammability
A strip of clean untreated Tyvek® when first exposed to an open flame, shrinks away from it. If the flame follows the strip, it will catch fire, burn slowly and drip melted polymer.

Corona treatment
Corona treatment on Tyvek® lasts for several years and keeps its surface resistivity of minimum 40 dyne/cm.

Neutral pH
Tyvek® has a neutral pH of 7. Also corona and antistatic treated styles have a pH of 7.

Toxicity
Tyvek® is classified as non-toxic. Testing on skin resulted in no irritation, swelling or allergic reaction.

2. PRINTING

Tyvek® can be successfully printed by using traditional as well as many digital processes, in both sheet and roll form.

2.1 GENERAL

Tyvek® can be printed the same way as paper, although some of its physical properties do require special attention.

Tyvek® is corona treated on both sides to improve ink adhesion and is coated with an antistatic agent to facilitate sheet printing and converting. Unlike with other materials, these treatments are permanent.

Tyvek® has no grain direction.

Tyvek® has a smooth and rough side. The difference can be felt or viewed using a low power magnifying glass or exposing to reflective light. Although Tyvek® is printable on both sides **it is recommended to use the smooth side for one-sided or full-coverage printing**.

Tyvek® has a unique fibre swirl pattern which is used to great effect in certain applications. This will show through most inks. It may be minimised by using light colours or a busy pattern.

2.2 PRECAUTIONS

Tyvek® is not as absorbent as paper and therefore inks may take longer to dry. The open nature of the Tyvek® surface, however, allows faster drying than other plastic/film substrates. In the timeline, three days should be allowed for two-side printing due to the need **of min. 24 hours dry time before printing the second side**.

It is important to identify critical colors in the planning and design stage. Color matching of ink must be done because a color shift will occur when going from paper to Tyvek®.

Tyvek® has an inherent thickness variation which can be compensated by adding more pressure.

Tyvek® is more elastic and should be handled under the lowest tension possible to avoid distortion and mis-registration.

Heavy edge to edge ink coverage and subsequent die cutting to smaller sizes may cause curling.
This effect can be avoided by leaving a 1-2 cm border on all sides.

Solvents: Certain solvents used in some inks, paints and adhesives may cause swelling of Tyvek®.
This effect is often reversible after evaporation of the solvent.
If a binder or vehicle is present in the solvent, the distortion may be permanent. Tyvek® may also be swollen or cockled by some plasticizers and aliphatic hydrocarbon resins used in inks and low molecular weight adhesives. This effect is generally permanent and may not be apparent for some time after application. Please refer Appendix 1: list of solvents and their effects on Tyvek®.

2.3. PRINTING ON TYVEK® FOR DIRECT FOOD CONTACT

Tyvek® for direct food contact is available in three styles.
These materials meet the requirements of title 21 of the US Code of Federal Regulations (21 CFR 177.1520) FDA and meets European requirements for materials directly in contact with food. Details for the certification as well as a copy of the certificate are available upon request. These Tyvek® styles are also suitable for toys application and compliant to the European Standard EN 71.3 "Safety of toys", regarding the migration levels of certain elements.The material is not corona treated therefore making it more resistant to ink absorption. We recommend to use flexo printing with the material. Please refer to the paragraph 2.6 on flexo printing. When processing this material, please note that it has not been antistatically treated.

2.4 INKS

In general, we recommend to use inks developed for printing on synthetic material.

It is possible to use standard paper inks on Tyvek® with satisfactory results, but this will depend generally on the ink formulation and the amount of ink coverage.
Always do a test and wait one day. We do recommend, however, that inks developed for use on PE synthetic are used. Please ask your ink manufacturer for the right ink for Tyvek®. Some hydrocarbon solvents used in certain commercial inks may cause swelling or cockling - either immediately or after the sheets have been printed. It is suggested that inks containing less than 3% residual solvents be used on Tyvek®.

If Tyvek® swells or cockles within 30 minutes of printing, the ink probably contains a residual solvent or plasticizer.

Aniline dye inks are not recommended for use on Tyvek®.

To reduce the tack of a litho/letterpress ink, "00" varnish, tung oil, or a reducer recommended by the ink supplier can be used.

2.5 OFFSET PRINTING

Design, Prepress and Printing tips (ICC-profile) can be downloaded from our website:
www.graphics.dupont.co.uk

Tyvek® is dimensionally stable and handles well on large or small, single and multicolour offset machines and on vertical, flatbed or rotary letterpress machines in sheet or web form.

Use recommended inks
Most ink suppliers have offset inks for Tyvek®. It is important to use low solvent content inks. The inks should contain less than 3% volatile solvent, since hydrocarbon solvents found in most offset inks will swell and distort Tyvek®.

Add more impression
Usually Tyvek® will require about 0.08 - 0.10 mm additional impression compared to a sheet of paper of equivalent thickness, because it is more compressible.

Reduce level of dampening solution
Tyvek® does not absorb water as readily as paper, for this reason, the press should be run with less dampening solution. If the printing is dull or washed out, reduce the amount of dampening solution, verify its pH (7 is ideal). Do not increase ink volume.

Print with the minimum ink film thickness
This will minimise dot distortion, sheet distortion and the appearance of fibre swirl and will also reduce ink drying time.
Offset inks dry more slowly on Tyvek® than on paper.
When doing full coverage multi-colour printing, keep the pile height below 50 cm.

Winding the sheets will accelerate drying.
Tyvek® is unaffected by alcohol and alcohol substitute dampening solution additives.

Either side of Tyvek® can be printed.
Generally, the smooth side is recommended.

Conventional blankets of medium hardness are recommended.

It is recommended that 4 colour work is conducted only on 4 colour machines, because Tyvek® is subject to stretching.

2.6 FLEXO PRINTING

Low temperature drying is the key to printing Tyvek® by flexography.

Use recommended inks. Most ink suppliers have flexo inks for Tyvek® in their product selection. Some hydrocarbon solvents used in certain flexo inks may cause swelling or cockling - either immediately or after the sheets have been printed. Inks containing less than 3% residual solvents should be used. Ink suitability should be tested before production.

Many different flexo inks are suitable for Tyvek®, like volatile solvent, waterbased and UV-curing inks, in each case, the volume of ink on Anilox roll needs to be adapted to type of Tyvek® and to print layout.

Pigmented polyamide/alcohol inks give increased adhesion and rub resistance. Water-based inks for PE print well, but drying time may be extended due to the low water absorption of Tyvek®. When printing Tyvek® 'B' grade, microcrystalline wax is usually added to inks to reduce set off.

Web temperature should be kept below 80°C and tension below 1.4 N/cm of width. This will help prevent mis-registration. The use of powered rollers and short unsupported web spans will help to maintain low unwind and processing temperatures.

Reduce the web temperatures prior to wind up on a chill roller. This helps to prevent blocking and minimizes distortion and is essential for printing 'B' styles of Tyvek®.

To help overcome the inherent thickness variation of Tyvek®, mount plates with 0.38 - 0.55 mm of sticky back closed cell foam tape.
DuPont™ Cyrel® Photopolymer plates produce the best overall print quality. Thin plates with thickness of 45/1.14mm can be used without any problem. The hardness of these plates should be 75° Shore A.
Harder plates at thickness of 67/1.7mm or 100/2.54mm can be used, when mounted with sticky back closed cell foam tape, to compensate the thickness variation with the foam and not with the plate. There is no difference for digital or analog plates. Multi-colour process printing is best accomplished with Cyrel® Photopolymer plates with 48 lines/cm screen, same requirements are valid for screen and fulltone areas.

Guidelines:
For water and solvent based inks, Anilox rolls with 260-340 L/cm and a volume of 3.5-4.5 g/cm³ are used for screen, volume of 4.5-6.0 g/cm³ are used for fulltone.

For UV-curing inks, same Anilox rolls can be used but for enough coverage on fulltone, the transferred volume should be higher than 8 g/cm³.

2.7 GRAVURE

Tyvek® is suitable for printing on equipment used for single/multi colour printing of paper, films and fabrics. The same techniques involved in flexo printing should also be applied to gravure with the following additions:

Cylinders with 39 lines/cm or more are preferred.

Type C nitrocellulose gravure inks are most widely used and they are often modified by the addition of an alkyd resin to improve ink hardness and adhesion.

2.8 SCREEN PRINTING

Tyvek® can be printed on hand, automatic and rotary screen presses in sheet and roll form for signs, banners and other decorative uses.

When high velocity hot air is used instead of room temperature drying, the sheet temperature should be kept below 80°C (175°F) with tension below 1.4N/cm to avoid mis-registration in multi-color web printing.

Use recommended inks. Most ink suppliers have screen printing inks for Tyvek® in their product selection.
Some solvents used in screen inks can cause undesirable swelling, distortion and mis-registration. Poster paints and enamels containing hydrocarbon solvents are not recommended for screen printing Tyvek®.
When using UV-cured screen inks, cooling is required to prevent sheet distortion or shrinking due to the heat generated within the ink when curing heavy coverage of dark solids. Since Tyvek® has a rougher surface than film substrates, a coarser screen (100 cm/255 in. mesh) provides better coverage.

Lacquer inks give the lowest degree distortion. Certain 'poster inks' contain a high percentage of mineral spirits. These should be avoided as they can cockle Tyvek®. For highest durability and adhesion use urethane inks.

When ink trapping will permit, the colour with the least coverage should be printed first, followed by increasing amounts of coverage, i.e. the colour with the greatest area coverage should be the last colour printed. This will minimise sheet distortion during multi-colour printing.

Inks containing fade resistant pigments are recommended for outdoor applications.

2.9 UV DRYING

Ultraviolet cure inks
These work well with all type of Tyvek®. They dry instantly and give higher density dark colours with improved gloss.
Short exposure to UV radiation will not affect the physical properties of the material, but a cooling system is recommended to reduce heat build up.

2.10 INFRARED CURE INKS

These high solvent inks are not recommended as they may cause Tyvek® to distort.

2.11 THERMAL TRANSFER PRINTING

a) Standard Tyvek®
For optimal results for thermal transfer printing on Tyvek®, it is important to choose the right combination of ribbons and printer settings. The same preconditions have to be met also when printing bar codes on Tyvek®.

In principle, all common thermal transfer printers are suitable for printing on Tyvek®. Tests have been made with TEC, Intermec, Avery, Zebra, Sato and Fargo.

Print head temperature has to be set suitably for the ribbon as well as for Tyvek®.

Bar Code Printing
Each type of bar code has several magnifications, from very dense codes (magnification 1) to very large codes (magnification 5).
For example, magnification 1 means that the thinnest bars are only 0.125mm wide. When printing bar-codes on standard Tyvek®, the best results can be achieved with magnification 4 and 5.

b) Tyvek Brillion®

Tyvek Brillion® has one very smooth side, which makes it suitable for thermal transfer printing of small images and high density bar codes.

All current thermal transfer printers - like Intermec, Zebra, Sato, Novexx Lion and Datamax - are suitable for printing on Tyvek Brillion®. Both traditional printers as well as printers with "Near Edge" techniques can be used. The readability of bar codes meets the 'B' requirements by ANSI.

In general, both wax and wax resins can be recommended, when printing on Tyvek Brillion®. The smudge and tear resistance of the print is better with wax resins than with wax. Print head temperature has to be set suitable for the ribbon as well as for Tyvek Brillion®. The temperatures needed for printing are higher with wax resins. However, the temperatures needed for printing on Tyvek Brillion® are generally lower than for paper.

Please note :

Tyvek Brillion® has more than 20% lower tear resistance and is therefore not recommended for applications with large perforated areas like for example wristbands.

Tyvek Brillion® is best for thermal transfer printing of small images and high density bar codes.

HP INDIGO CERTIFIED SUBSTRATE

2.12 INKJET / UV-INKJET

Standard Tyvek® cannot be inkjet-printed with water based inks. Also oil-based inks are not recommended.

Fast drying solvent based inks are required when printing on standard Tyvek®, but in general, print quality is poor, as colors are very pale and fade.

For best print quality, coated Tyvek®, available from different coaters ,has to be used. Coated Tyvek® is suitable for printers with water or solvent-based inks like HP, Epson, Kodak, Roland, NUR, Vutek, Mutoh, etc. and is a mat white product with excellent print quality and very high durability. Coated Tyvek® can also be printed with ECO-solvent inks. Please contact us for further details and coaters.

Standard Tyvek® can easily be printed with UV-Inkjet (Durst, EFI-Vutek, AGFA, NUR, HP/Scitex, OCE, Matan, etc.), but it's recommended to use only 75 or 105 g/m² material.

Tyvek® 75 and 105g/m² can also be printed by Océ ColorWave 650 using Océ CrystalPoint technology.

2.13 DIGITAL PRINTING

Standard Tyvek® can be easily printed on digital offset printers like **HP Indigo** (certified on industrial printers) *https://h21021.www2.hp.com/medialocator/NewMediaLocator.aspx*

On HP Indigo sheet fed printers, only the 75 and 105g/m² runs acceptable.

Tyvek® can also be printed on UV-inkjet Narrow web Label printer (Tau 150 and 330 from DURST and Jetrion 4000 series from EFI) and on wax printers like XEROX Phaser.

But Tyvek® is not suitable for digital printers working at temperatures exceeding the melting point of Tyvek® (for example Xeikon).

2.14 DOT MATRIX

Tyvek® can be easily printed on with dot matrix systems.
No special precautions are necessary.
Due to its surface and ability to absorb inks Tyvek® offers:
– no smearing of colors after printing
– good anchorage and high abrasion resistance of the print

2.15 LASER PRINTING AND PHOTOCOPYING

Today, laser-based electrophotography is being used more widely for high speed black and white and colour copiers. These copiers use lasers to activate (deactivate) the charged drums.The laser beam does not contact Tyvek® during the printing operation. However, conventional laser printing is not recommended because of the temperature involved in the printing units, which will melt Tyvek® and cause a breakdown of the printing.
For the same reason, Tyvek® should not be used in electrostatic copiers.

3. HOW TO CONVERT TYVEK®

3.1 GENERAL

Tyvek® will stretch up to 30% before breaking.
To minimise distortion or neck down during roll fed converting, keep tension less than 1.4N/cm (0.75 pounds/inch). This is especially important when die cutting Tyvek® business forms with rotary punched sprocket holes.
Tyvek® can be converted in much the same way as paper or plastic films and using the same equipment.

3.2 SLITTING, SHEETING, CUTTING

Because Tyvek® fibres are very strong, each must be thoroughly cut; 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, but a sharp edge is preferred for other slitting methods.

3.3 ROTARY DIE PUNCHING

Because soft steel male/female rotary dies dull quickly when set to the close tolerances required to punch Tyvek® cleanly, the use of rotary dies made of hardened tool steel or tungsten carbide is recommended.

3.4 DIE CUTTING

Tyvek® can be die-cut using either steel rule, male/female or closed dies. Tyvek® fibres must be completely cut and dies must be in good condition with sharp, nick-free edges. Dull dies cause edges to curl. When using closed dies, the use of a side cutter with internal relief is recommended. De-aerate and keep lift height below 7.2cm (3 inches) when die cutting to avoid oversizing top blanks.

3.5 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.

3.6 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.

3.7 PERFORATING

To make clean tearing perforations a 10:1 cut to reserve ratio is recommended, e.g. 8.0 mm cut: 0.8 mm reserve (5/16 in.: 1/32 in.). Tear initiation can be assured by positioning a cut at the edge of the sheet.

3.8 EMBOSSING

Tyvek® can be embossed with either high or low pressure equipment. Cold embossing does not significantly reduce the strength of Tyvek®. It does, however, reduce opacity. Embossing cylinders used for Tyvek® usually are very shallow, having a depth of only 0.13-0.65 mm (5-25 mils).
A shore D hardness of 70-80 for the rubber backup cylinder is preferred.

3.9 HOT FOIL STAMPING

This is readily accomplished on Tyvek® due to its thermoplastic nature. A variety of foils is available from suppliers for label and book cover applications. A foil that will transfer cleanly to Tyvek® between 135 -160°C should be chosen. Large, solid foil-stamped areas tend to pucker and distort Tyvek® and should be avoided.
To avoid pucker and distortion, Tyvek® 105g/m² or self-adhesive coated Tyvek® is recommended.

3.10 DYEING

Conventional textile dyeing processes do not impart permanent colour to Tyvek®. However, Tyvek® can be printed on by flexographic or gravure processes.

3.11 LAMINATING

Tyvek® can be extrusion-, adhesive-, flame-, ultrasonic-, thermal- and calender laminated. Extruded low density polyethylene (LDPE) is an excellent adhesive for laminating foil and film to Tyvek®. Polyurethane adhesives can be used to adhere a variety of films and fabrics to Tyvek®. When laminating Tyvek® to paper or board, it is important to completely cover Tyvek® with adhesive to prevent bubble formation. Polyurethane adhesives or Hotmelt (Euromelt 772 from Henkel or Lunamelt KC2010 from H.B.Fuller) are recommended. Recycled board is not recommended, since the board can contain remaining solvents or binders, which can cause bubble formation.

3.12 COATING

Coatings are used to color, improve print fidelity, add gloss or mask the fiber pattern in Tyvek®. Air-knife coating is preferred for aqueous coating because it applies a uniform thickness.
Usually an increase in binder content is needed to achieve acceptable coating adhesion to Tyvek®. The air knife also produces a very smooth surface which is ideal for printing. Gravure coating is preferred for solvent-based systems, particularly where deep coloration is required. Tyvek® can be extrusion coated using special polymers. When coating or laminating Tyvek®, the web temperature should not exceed 80°C.

3.13 HEAT SEALING, DIELECTRIC SEALING, ULTRASONIC SEALING

High seal strength can be achieved using hot-bar or impulse techniques sealing Tyvek® to Tyvek®. Heat sealing Tyvek® to itself or other films is usually accomplished by applying a heat seal coating such as branched (low density) polyethylene (LDPE) to one of the materials. Tyvek® cannot be dielectrically sealed under ordinary conditions because it is non-polar. Ultrasonic sealing can be used to create fiber tearing seals with most of Tyvek® styles and without the puckering that is often associated with heat seals.

3.14 GLUING

Natural product adhesives based on dextrin, casein or animal by-products can be used to adhere Tyvek® to itself and a variety of paper materials. Water based synthetic lattices such as the ethylene/vinyl acetate adhesives form fibre tearing bonds with Tyvek®. Hot melt polyamide adhesives are available which form good bonds to Tyvek® with a variety of materials. Acrylic pressure sensitive adhesives are commonly used with a release liner. Please refer to the solvents list on page 17 before using your adhesive. Some of the components may interact with Tyvek®.

3.15 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®, lowest possible stitch frequency (2-3 stitches per cm with low tension) and the smallest needle should be used. The needle should have a flat point to produce perforating slits. It can be recommended to use chain and aligned stitches, especially 2,5 cm chain stitch.

3.16 CONVERTING TIPS FOR CONTINUOUS BUSINESS FORMS

Sheet tension

Tyvek® is more elastic than paper and tends to stretch under tension but recovers after perforating punching. Tension has to be controlled so that perforation is according to DIN 6771.

The following qualities are recommended for business forms:

1057D (55 g/m²)
1073D (75 g/m²)
1082D (105 g/m²)

Machine speed

As the machine speed increases, the tension adjustment decreases. If the hole distance is short, at a particular tension (i.d. at 100 m/mn), it will be shorter at 300 m/mn.

Punching

Best results are obtained with sharp, well registered and closely fit punches.

Rotary sprocket punching

Rotary sprocket punching of Tyvek® should be done with male female dies made from hardened tool steel or tungsten carbide.

Tearing perforation

To make clean tearing perforation, use the maximum practical number of cuts with the smallest land between them and a 10 to 1 ratio. Tear initiation can be assured by positioning a cut across the edge of the sheet.

Printing

Please refer to printing sections in this brochure.

4. AN EFFICIENT USE OF RESOURCES

DuPont is committed to the efficient and safe handling of plastics waste and advocates a resource optimisation and waste management system with the following priorities:

1. Resource minimisation
2. Recycle/reuse
3. Recover energy
4. Landfill

DuPont is certified ISO 14001: 2004

4.1 RESOURCE MINIMISATION

Tyvek® is very strong and light weight, so less material is needed to perform many functions. The weight of material in a product made from Tyvek® can be much lower than that made from other materials for the same or superior performance.

4.2 RECYCLE/REUSE

Mechanical recycling

Being 100% HDPE, 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 flowerpots. Products made from Tyvek® which are printed, glued, welded or sewn can also be recycled as can Tyvek® which has been extrusion coated or laminated with a polymer of the same family. Polyethylene can normally be recycled 4 to 5 times before physical properties are substantially affected.

Chemical feedstock recycling

Tyvek® can be chemically recycled with other polymers. In this process the original material is separated into its chemical components, which are then recovered for reuse.

4.3 ENERGY RECOVERY

When incinerated in excess oxygen Tyvek® yields only water and CO^2. It is excellent in 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.

4.4 LANDFILL

Whilst DuPont does not encourage landfill, Tyvek® can, as a last resort, be safely disposed of in this way. It will not leach into groundwater because it's chemical inert and doesn't contain binders, fillers and plasticizers.

4.5 WHERE TO RECYCLE TYVEK®

At the end of their useful life, products made from Tyvek® can be recycled via your local recycler for polyethylene waste. Additionally DuPont has set up a network of recyclers who have agreed to take back items made from Tyvek® for mechanical recycling into other products. (The items sent for recycling must not have been in contact with any hazardous substance):

Ravago Plastics Luxembourg S.A.
Rue des Ateliers
Zoning industriel de Latour
B - 6761 Virton
Tel.: +32-63-581 736, Fax: +32-63-581 738

B-Plast 2000
D - 26605 Aurich
Tel.: +49 4941 60020

Paprec Plastiques 44
5-7 rue Piliers de la Chauviniere
BP 60195 - F-44802 Saint Herblain cedex
Tel.: +33 (0)2 40 16 96 00

APPENDIX 1

MANUFACTURERS OF ADHESIVES RECOMMENDED FOR TYVEK®

H.B. Fuller
http://www.hbfuller.com/eimea/about-us

Henkel
http://www.henkel.com

Planatol Klebetechnik GmbH
http://www.planatol-adhesive.com

SOLVENTS

Order of increasing swelling effect of solvents on 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 methylether	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 methylether	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.

APPLICATIONS

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Photo courtesy Shira Keret

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