Tyvek Clean Room Materials (Grade 1056D)
Meets Federal Standard 209D Requirements

Experts have long recognized that paper based products are not of the major source of particulate contamination in the clean room. In addition to pulped wood fibers, paper also contains cotton and linen fibers, clays, starches, bleaches (chlorine), metals, chemicals, minerals, and salts.

As the paper product is used and abraded during normal handling, it begins to break down. This process is accelerated, and great amounts of damaging particulate contamination are generated if the paper products is subjected to rough handling, is torn, unusually abraded or becomes wet. The mineral crystals and salts contained in these particles are particularly damaging to semiconductor and electronic devices.

The obvious solution to this problem is to replace the paper materials with synthetic substitutes. Tyvek has proved to be an ideal medium for this purpose. This spun bound olefin is a family of tough, durable, sheet products of high density polyethylene fibers. The sheet is formed by first spinning continuous strands of very fine interconnected fibers and then bonding them together with heat and pressure. Due to its lint-free, non-particle generating qualities, it is suitable for unlimited clean room applications. Tyvek is water, acid, salt, base, and solvent resistant as well as dimensionally stable and static free. Its inherent durable nature makes it a superior media for high humidity and cryogenic atmospheres as it does not fray, wear, tear, or shed particles. The light weight, smooth surface makes Tyvek well suited for use as a printable substrate while providing an excellent shelf like for record keeping. The construction avails itself for usage as wafer separator, storage envelopes, and any other number of applications. Where shock, abrasion, or product scratching are major concerns.

Tyvek products are all nitrogen showered and double wrapped for protection.
Typical Properties of Tyvek Type 10 Superbound Olefin

<table>
<thead>
<tr>
<th>Test Method</th>
<th>Basis weight, oz./sq. yd.</th>
<th>Thickness, mils</th>
<th>Strip tensile (MD(^{(2)})), lbs./in.</th>
<th>Strip tensile (XD(^{(2)})), lbs./in.</th>
<th>Elongation at break (MD), %</th>
<th>Elongation at break (XD), %</th>
<th>Tear Elmendorf (MD), lbs.</th>
<th>Tear Elmendorf (XD), lbs.</th>
<th>Opacity, Eddy, %(^{(3)})</th>
<th>Porosity, Gurley, sec./100cc./sq. in.</th>
<th>Internal bond, lb./in.</th>
<th>Water resistance hydrostatic pressure test, in.</th>
<th>Electrical surface resistivity, log R</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATM-D3776(^{(4)})</td>
<td>1.60</td>
<td>6.0</td>
<td>26</td>
<td>29</td>
<td>17</td>
<td>23</td>
<td>1.0</td>
<td>1.0</td>
<td>89</td>
<td>84-94</td>
<td>0.34</td>
<td>-</td>
<td>-</td>
<td>Corona/Antistat both sides</td>
</tr>
<tr>
<td></td>
<td>1.50-1.70</td>
<td>3.0-9.0</td>
<td>21-31</td>
<td>21-37</td>
<td>12-22</td>
<td>18-28</td>
<td>.05-1.5</td>
<td>.05-1.5</td>
<td></td>
<td></td>
<td>0.24-0.44</td>
<td>-</td>
<td>7.8</td>
<td>-</td>
</tr>
<tr>
<td>ATM-D1777(^{(5)})</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-</td>
<td>7.0-8.6</td>
<td></td>
</tr>
<tr>
<td>ATM-D1777(^{(6)})</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-</td>
<td>AATCC 76(^{(8)})</td>
<td></td>
</tr>
<tr>
<td>ATM-D2724(^{(7)})</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AATCC 76(^{(8)})</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>-</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^{(1)}\) Ranges are estimated only for 95% of the product based upon roll averages standard deviations accepted thickness ranges which are based on individual specimens  
\(^{(2)}\) MD is Machine Direction, XD is Cross Direction  
\(^{(3)}\) 100% is opaque  
\(^{(4)}\) 1 sq. yd.  
\(^{(5)}\) 7.15 psi pressure, 0.62 in. Dia. Pressure foot  
\(^{(6)}\) Cut Strip; CRE tensile tester, crosshead speed 2 in./min., gauge length 5 in.  
\(^{(7)}\) CRE tensile tester, crosshead speed modified 5 in./min., distance 2.5 in. Peel  
\(^{(8)}\) Converted to log R
Leachable Anions and Cations by Ion Chromatography (IC)

Concentration in \(10^{10}\) molecules/cm\(^2\)

<table>
<thead>
<tr>
<th>Anions:</th>
<th>DL*</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluoride ((F^-))</td>
<td>50</td>
<td>41,000</td>
</tr>
<tr>
<td>Chloride ((Cl^-))</td>
<td>30</td>
<td>8,600</td>
</tr>
<tr>
<td>Nitrite ((NO_2^-))</td>
<td>30</td>
<td>470,000</td>
</tr>
<tr>
<td>Bromide ((Br^-))</td>
<td>20</td>
<td>&lt;20</td>
</tr>
<tr>
<td>Nitrate ((NO_3^-))</td>
<td>20</td>
<td>8,700</td>
</tr>
<tr>
<td>Sulfate ((SO_4^{2-}))</td>
<td>10</td>
<td>540</td>
</tr>
<tr>
<td>Phosphate ((PO_4^{3-}))</td>
<td>10</td>
<td>200,000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cations:</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Lithium ((Li^+))</td>
<td>200</td>
<td>&lt;200</td>
</tr>
<tr>
<td>Sodium ((Na^+))</td>
<td>50</td>
<td>29,000</td>
</tr>
<tr>
<td>Ammonium ((NH_4^+))</td>
<td>50</td>
<td>3,400</td>
</tr>
<tr>
<td>Potassium ((K^+))</td>
<td>30</td>
<td>1,400,000</td>
</tr>
<tr>
<td>Magnesium ((Mg^{2+}))</td>
<td>50</td>
<td>600</td>
</tr>
<tr>
<td>Calcium ((Ca^{2+}))</td>
<td>30</td>
<td>4,600</td>
</tr>
</tbody>
</table>

*DL = detection limits are in \(10^{10}\) molecules/cm\(^2\)

Note:
The polyethylene foam with a surface area of 64 cm\(^2\), as determined by dimensions, and Tyvek sample with a surface area of 26 cm\(^2\) were leached in DIW at room temperature for 24 hours.
Material Safety Data Sheet

Tyvek® SPUNBONDED OLEFIN; 1056D 1.6 oz/yd²

Product Background:

- Tyvek® has been manufactured and converted into industrial and consumer products since 1967 without any identifiable health effects. Tyvek®, as sold by DuPont, is non-hazardous and presents no known health hazards. Tyvek® is used for disposable protective apparel to protect workers from asbestos particulate hazards, the packaging of sterile medical devices and a variety of other demanding applications.

CHEMICAL PRODUCT/COMPANY IDENTIFICATION

Company Identification

MANUFACTURER/DISTRIBUTOR

E. I. du Pont de Nemours and Company, Inc.

1007 Market Street

Wilmington, DE 19898

PHONE NUMBERS

Product Information: 1-800-441-7515

Transport Emergency: CHEMTREC 1-800-424-9300

Medical Emergency: 1-800-441-3637

COMPOSITION/INFORMATION ON INGREDIENTS

Components

<table>
<thead>
<tr>
<th>Material</th>
<th>CAS Number</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polyethylene</td>
<td>9002-88-4</td>
<td>&gt;98</td>
</tr>
<tr>
<td>Proprietary Antistatic Agent</td>
<td></td>
<td>0- 1.3</td>
</tr>
</tbody>
</table>

Remarks
DuPont Tyvek® is a continuous fiber form of high density polyethylene composed of carbon and hydrogen. The polymer contains typical polyolefin processing additives, each of which is present at a weight concentration of less than 1.0%. Some styles of Tyvek® are coated with an antistatic agent.

This MSDS is for Type 10, 14, and 16 Tyvek® spunbonded olefin products made in North America. There are separate MSDS's for coated Tyvek® products, such as Tyvek® FC, Tychem® QC and the Tychem® family of chemical barrier fabrics.

HAZARDS IDENTIFICATION

Potential Health Effects

Tyvek® has been manufactured and converted into industrial and consumer products since 1967 without any identifiable health effects.

Tyvek® may be categorized as essentially non-toxic. The nature of the product make either ingestion or inhalation highly improbable. Normally, converting presents no dust hazard from Tyvek®.

Eye contact will produce a mechanical irritation like any foreign object.

Skin contact should produce no skin irritation, swelling, or sensitization.

Human - Testing using a panel of 20 men and women performed using Tyvek® spunbonded olefin with up to 3.0% antistatic agent with a 48-hour contact time produced no skin redness or swelling.

Modified Draize Repeated Insult Patch Test Study using a panel of 106 men and women was performed using Tyvek® style 1422A produced no skin redness, swelling, or skin sensitization.

Carcinogenicity Information

None of the components present in this material at concentrations equal to or greater than 0.1% are listed by IARC, NTP, OSHA or ACGIH as a carcinogen.

FIRST AID MEASURES

First Aid - Eye Contact

Mechanical irritation - remove particle. Seek medical help if irritation persists.

FIRE FIGHTING MEASURES
Flammable Properties

Products made from Tyvek® are not intended for use in fire-retardant garments. Fabrics of Tyvek® should not be used near heat, flame, sparks nor in explosive environments.

When exposed to a flame, Tyvek® shrinks away rapidly. If the flame is made to follow the shrinking sheet, Tyvek® will melt at 275 F (135 C) and if the auto-ignition temperature of (400 C) is reached, Tyvek® will burn.

Type 14 and type 16 Tyvek® are rated "Class 1- Normal Flammability" by the Federal Flammable Fabrics Act for Clothing Textiles (16 CFR 1610). Type 14 Tyvek® fabric does not pass DOC FF 3-71, "Children's Sleepwear Test" and does not pass NFPA 701.

Gases/vapors produced in fire from complete combustion of Tyvek® are CO2 and water. Incomplete combustion yields hazardous gases/vapors including CO, acrolein, other aldehydes, ketones, fatty acids and short-chain hydrocarbons.

Static Discharge

Some styles of Tyvek® do not contain an antistatic agent. These styles can build a static charge during roll or sheet handling operations and care should be used when handling in areas where potential for flammable or explosive vapor/air mixtures exist. In low humidity conditions, all styles of Tyvek® whether they contain an antistatic coating or not, can build a static charge.

Extinguishing Media

Water, Dry Chemical, CO2.

Wear self-contained breathing apparatus.

ACCIDENTAL RELEASE MEASURES

Safeguards (Personnel)

Not applicable

Spill Clean Up

Not applicable.

HANDLING AND STORAGE

Handling (Personnel)

Avoid contact with eyes.

Tyvek® is slippery. Care should be used in moving it. It should not be left in a walkway where it
may be walked upon and a person could slip and fall.

Handling (Physical Aspects)
Keep away from heat, sparks and flames.

In low humidity conditions, all styles of Tyvek® whether they contain an antistatic coating or not, can build a static charge.

Storage
Do not store with strong oxidizing acids.
Keep from heat and flames.

Do not expose to exhaust gases from internal combustion engines or heaters. Prolonged exposure will cause outer wrap and edges to turn yellow or pink. Storage area should be ventilated.

Do not stack rolls more than four (4) units high. Rolls should be stored vertically on pallets.

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**EXPOSURE CONTROLS/PERSONAL PROTECTION**

Personal Protective Equipment
Eye/Face: None normally needed.
Respirator: None normally needed.
Protective Gloves: None normally needed

Exposure Guidelines

Applicable Exposure Limits
Polyethylene
PEL (OSHA): None Established
TLV (ACGIH): None Established

AEL * (DuPont): 10 mg/m3, 8 Hr. TWA, total dust
AEL * (DuPont): 5 mg/m3, 8 Hr. TWA, respirable dust

* AEL is DuPont's Acceptable Exposure Limit. Where governmentally imposed occupational exposure limits which are lower than the AEL are in effect, such limits shall take precedence.

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**PHYSICAL AND CHEMICAL PROPERTIES**
ESD – Semiconductor and Electronic Packaging and Handling Products
Physical Data

Melting Point : 110-140 C (230-284 F) @ 760 mm Hg
% Volatiles : <0.1 wt% @ 25 C (77 F)
Solubility in Water : Insoluble
Odor : Odorless
Form : Sheets or Rolls
Color : White
Specific Gravity : 0.95-1.00 g/cc

STABILITY AND REACTIVITY

Chemical Stability

Stable.

Aromatic hydrocarbons, gasoline, lubricating oils, and halogenated hydrocarbons will soften and swell Tyvek®.

Incompatibility with Other Materials

Products made from Tyvek® should not be stored in contact with strong oxidizing agents, especially at elevated temperatures as is the case for most olefin polymers.

Decomposition

Exothermic oxidation starts to occur at 335 C (635 F). Autoignition occurs at 400 C (750 F). Incomplete combustion yields hazardous gases/vapors including CO, acrolein, other aldehydes, ketones, fatty acids, and short-chain hydrocarbons.

Polymerization

Polymerization will not occur.

ECOLOGICAL INFORMATION

Ecotoxicological Information

Aquatic Toxicity

Non-toxic - insoluble

DISPOSAL CONSIDERATIONS
Waste Disposal

Treatment, storage, transportation, and disposal must be in accordance with applicable Federal, State/Provincial, and Local regulations. See Section on Regulatory Information under RCRA.

TRANSPORTATION INFORMATION

Shipping Information

DOT/IMO Proper Shipping Name: DuPont Tyvek®
DOT Hazard Class: Not regulated material
I.D. No. (UN/NA): Not regulated material
DOT Label(s): Not regulated material
Subsidiary Hazard Class: Not regulated material
Reportable quantity: Not regulated material

REGULATORY INFORMATION

Toxic Substance Control Act (TSCA)

Tyvek® is considered an “article” under provisions of TSCA. All non-exempt chemical components are included in the TSCA inventory of chemical substances compiled by U.S. Environmental Protection Agency (EPA) as well as on the European chemical inventory (EINECS).

Occupational Safety & Health Act (OSHA)

Tyvek® is considered a non-hazardous material under provision of the Hazard Communication Standard (29 CFR 1910.1200). This MSDS is not required but is provided to Tyvek® customers as a service. Resource Conservation and Recovery Act (RCRA)

Tyvek® is not a hazardous waste as defined by regulations implementing the Resource Conservation and Recovery Act (RCRA). Tyvek® waste materials should be disposed of in compliance with Federal, State and Local regulations. Preferred options for disposal are (1) recycling, (2) incineration with energy recovery, and (3) landfill. The high fuel value of this product makes option #2 very desirable for material which cannot be recycled. TYVEK® is essentially pure polyethylene and it is being recycled along with other common plastics such as milk bottles.

Tyvek® will not disperse in water. So, while it can be disposed of with normal trash, it should never be put in with paper waste which will be repulped. Tyvek® is not readily biodegradable and
contains no significant percentage of material extractable in water so its effect on ground water in case of land-fill disposal should be negligible. The antistatic is biodegradable. Tyvek® can be disposed of safely by incineration. The products of complete combustion are carbon dioxide and water which are found naturally in atmosphere and are not considered toxic to human beings for the environment. Upon combustion with insufficient air, carbon monoxide and gaseous hydrocarbons may be generated. See also section entitled: "FIRE FIGHTING MEASURES".

Modern incinerators can handle widely varying concentrations of plastic materials. Their efficient operation depends on the proper ratio of plastic and organic material, such as paper, in the waste to be burned, and an adequate supply of air to insure complete combustion. Incinerating Tyvek® requires burning temperatures in the 1500-1900 F (816-1038 C) range to burn smoke and combustible gases. 100-300% excess air is required to maintain desired gas temperatures. Overall hourly heat release rate (feed rate) should be kept at or below 12,000 BTU per cubic foot (4.47 x 108 joules per cubic meter) of combustion space. It is preferable to mix Tyvek® 50% with waste paper because, when burned, Tyvek® can release about 2.5 times the heat released by cellulosic products.

Tyvek® waste, provided it has not been contaminated with any toxic material, has been shredded or palletized and reused for extruded plastic applications. Food and Drug Administration (FDA) Some styles of DuPont Tyvek® are not suitable for applications involving direct food contact. Before using any Tyvek® product in a direct food contact applications, contact Tyvek® Product Information at 800-44-TYVEK® (800-448-9835). DuPont takes the position that apparel constructed of antistatic treated, type 14 Tyvek® Spunbonded Olefin products, may be worn by food processors without prior approval of the USDA or FDA, as long as the apparel is limited to accidental food contact, is clean and is in good repair. Antistatic treated Tyvek® Spunbonded Olefin products are not suitable for repeated, direct and prolonged food contact applications, such as gloves, packaging and carrying containers Comprehensive Environmental Response, Compensation and Liability Act (Superfund) The Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) or "Superfund" levies a tax on hazardous waste materials expected to remain at a hazardous waste disposal facility after its closure (i.e., landfills). Tyvek® is not regulated as hazardous waste and is not subject to this Superfund tax. Emergency Planning and Community Right-To-Know Act (EPCRA) Tyvek® contains no chemicals in concentrations reportable under Section 313 of EPCRA. California Safe Drinking Water and Toxic Enforcement Act 1988 (Proposition 85) Tyvek® contains none of the substances known to the state of California to cause cancer or reproductive toxicity. Coalition of New England Governments (CONEG) Tyvek® meets the requirements for heavy metal content. Pennsylvania and New Jersey Right-To-Know Laws Tyvek® is non-hazardous and not subject to provisions of the Pennsylvania and New Jersey Right-To-Know laws.

OTHER INFORMATION

NFPA, NPCA-HMIS

Health: 0 Flammability: 1 Reactivity: 0 Personal protection rating supplied by user depending on use conditions.

CAUTION: DO NOT USE IN MEDICAL APPLICATIONS INVOLVING PERMANENT OR TEMPORARY IMPLANTATION IN THE HUMAN BODY OR CONTACT WITH BODY FLUIDS.

ESD – Semiconductor and Electronic Packaging and Handling Products
FOR OTHER MEDICAL APPLICATION, SEE DUPONT CAUTION BULLETIN NO. H-50102.

Packaging -

Tyvek® Spunbonded Olefin Products are packaged and shipped as single or multiple rolls of continuous spunbonded sheet on paper cores. Packaging materials are labeled with the product name, Tyvek®, and address of manufacturing plant. The label also contains style and roll identification numbers. Some styles of Tyvek® can build a static charge and should not be unwrapped or handled in areas where potential for flammable or explosive vapor/air mixtures exist.

The data in this Material Safety Data Sheet relates only to the specific material designated herein and does not relate to use in combination with any other material or in any process.

Responsibility for MSDS: David Welch

Address: DuPont Nonwovens, Laurel Run Building, Wilmington, DE 19880-0705

Telephone: 1-800-222-5676

Tychem® is a DuPont registered trademark.