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MSDS# SP1889: DuPont KEVLAR® Brand Fiber

Revised: April 19, 2004

**DUPONT**  
Material Safety Data Sheet**DuPont Kevlar® Brand Fiber****1. Chemical Product and Company Identification**

**MSDS NUMBER:** SP1889

Revision Date: April 19, 2004

**MANUFACTURING/DISTRIBUTOR**

E.I. du Pont de Nemours and Company  
Advanced Fibers Systems  
Spruance Plant  
P.O. Box 27001  
Richmond, VA 23261

**PHONE NUMBERS**

Product Information: (800) 931-3456  
Transport Emergency (800) 424-9300 CHEMTREC  
Medical Emergency (800) 441-3637

**TRADE NAMES/SYNONYMS**

KEVLAR® Aramid Yarn	KEVLAR® Brand Yarn
KEVLAR® Aramid Staple	KEVLAR® Brand Staple
KEVLAR® Aramid Pulp	KEVLAR® Brand Pulp
KEVLAR® Aramid Floc	KEVLAR® Brand Floc
KEVLAR® Aramid Fabric	KEVLAR® Brand Fabric
Aramid Yarn	KEVLAR® Brand Spunlaced Fabric
PPD-T (Para-phenylenediamine terephthalamide)	KEVLAR® Brand Fiber

**2. Composition/Information on Ingredients**

<u>MATERIAL</u>	<u>CAS Number</u>	<u>Wt. %</u>
• Poly (p-phenylenediamine terephthalamide) (para-aramid polymer)	26125-61-1	>89
• Water, absorbed Wet pulp	7732-18-5	0-7 35-70
• Finish	None	<2

All percentages are based on dry fiber weight.



DuPont Advanced Fibers Systems, P.O. Box 27001, Richmond, VA 23261

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KEVLAR® is a registered trademark of E.I. du Pont de Nemours and Company.

### **3. Hazards Identification**

#### **EMERGENCY OVERVIEW**

KEVLAR® fiber is a golden yarn, staple, flock, pulp, or fabric. As shipped, these products pose no immediate hazard. Processing and handling can produce airborne respirable fibrils (subfibers). Animal studies indicate that prolonged overexposure to such fibrils has the potential for lasting lung damage. Use ventilation or a respirator to minimize fibril inhalation.

Do not touch moving threadlines of KEVLAR® fiber.  
Entanglement with this high strength fiber can severely cut or even sever fingers.

During a fire, these KEVLAR® products are unlikely to pose a respirable fibril hazard, but may release toxic and irritating gases, much like those of wool. KEVLAR® will burn only with added heat, but pulp and dust may smolder. KEVLAR® pulp and dust do not present an explosion hazard.

If permitted to dry, pulp can become electrostatically charged during processing and handling. Electrostatic discharge may cause ignition of nearby flammable vapors. If the package is opened, or punctured, re-moisturize pulp to at least 4% moisture before using.

KEVLAR® fibers are non-biodegradable and nontoxic to aquatic life; they pose no unusual environmental hazard in a spill or fire.

#### **POTENTIAL HEALTH EFFECTS:**

##### **EYE**

Fiber fly and dust may cause slight mechanical irritation.

##### **SKIN**

Continual rubbing of fibers and fiber pieces on the skin (as when trapped under cuffs or collar, or when constantly handling fabrics) may cause irritation. Based on animal tests, the fibers do not cause sensitization (allergic reaction).

##### **INGESTION**

Based on animal studies, KEVLAR® is nontoxic when eaten.

##### **INHALATION**

KEVLAR® fiber is too big to inhale into the lungs, but fiber dust and fly from processing may be breathed into the nose and throat. Working unprotected in dusty conditions may cause upper respiratory irritation and cold-like symptoms.

##### **CHRONIC EFFECTS**

Processing KEVLAR® or machining materials containing KEVLAR®, may create fiber dust in the air small enough to be breathed into the lungs. Based on animal tests, breathing this dust at very high concentrations repeatedly over long periods of time may cause lung injury (fibrosis).

##### **CANCER**

IARC classified p-aramid respirable fibrils as Group 3, "not classifiable as to carcinogenicity in

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humans,” in October, 1996. That is, after reviewing all published toxicological literature on p-aramid, they found no convincing evidence of carcinogenicity. (See the TOXICOLOGY section and references contained in the “OTHER INFORMATION” section of this MSDS).

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.

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#### **4. First Aid Measures**

##### **EYE CONTACT**

In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Call a physician if irritation persists or develops later.

##### **INHALATION**

If large amounts of fumes, dust or fibers are inhaled, remove to fresh air. If breathing is difficult, give oxygen and call a physician. If persistent cough or other symptoms develop, get medical attention.

##### **SKIN CONTACT**

If fibers irritate the skin, wash with soap and water. Wash contaminated clothing before reuse. Use hand creams to soothe and moisten irritated skin. Get medical attention if irritation persists after contact stops.

##### **INGESTION**

Not a probable route. However, in case of gastro-intestinal distress following accidental ingestion, call a physician.

#### **5. Fire Fighting Measures**

##### **FLAMMABLE PROPERTIES**

Flash Point: Not Applicable  
Auto-ignition: Not Applicable  
Explosive Limits: Not Applicable

KEVLAR® fiber is inherently flame resistant, but can be ignited (limiting oxygen index = 29). Burning normally stops when the ignition source is removed. Pulp and dust accumulations may continue to smolder once ignited. KEVLAR® fiber dust does not present an explosion hazard.

##### **FIRE AND EXPLOSION HAZARDS**

Burning KEVLAR® produces hazardous gases similar to those from wool. These are mostly carbon dioxide, nitrogen oxides and small amounts of hydrogen cyanide, ammonia, aldehydes, aliphatic hydrocarbons and other toxic gases, depending on conditions of burning.

##### **CAUTION**

If permitted to dry, pulp can become electrostatically charged during processing and handling. Electrostatic discharge may cause ignition of nearby flammable vapors. Close package tightly after opening to retain moisture. If package is opened or punctured, re-moisturize pulp to at least 4% moisture before using.

##### **EXTINGUISHING MEDIA:**

Water, Foam, Dry Chemical, CO<sub>2</sub>.

##### **FIRE FIGHTING INSTRUCTIONS:**

Wear self-contained breathing apparatus.  
Keep personnel removed and upwind of fire.

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Wear full protective equipment (full Bunker gear).

## ***6. Accidental Release Measures***

### **SAFEGUARDS (Personnel)**

NOTE: Review FIRE FIGHTING MEASURES and HANDLING sections before proceeding with clean up.

Use appropriate PERSONAL PROTECTIVE EQUIPMENT during clean up.

### **ACCIDENTAL RELEASE MEASURES**

Wash, shovel or mop up and place in solid waste containers.

Fiber is not biodegradable; do not flush to drains.

Clean up dusts and pulp with high efficiency particulate air (HEPA) filtered vacuum equipment, or by wet cleaning. Avoid the use of dry sweeping or air jet blowing of fibers and dust, which can re-suspend respirable dust in the air.

## ***7. Handling and Storage***

### **HANDLING (Personnel)**

Do not touch moving threadlines of KEVLAR® fiber.

Entanglement with this high strength fiber can severely cut or even sever fingers.

### **STORAGE**

KEVLAR® is degraded by ultraviolet light. Do not store in direct sunlight. Fluorescent lighting will cause discoloration, but will not affect fiber mechanical properties.

Dry and wet KEVLAR® pulp is packaged in moisture-proof bags or bales to prevent drying to less than 4% moisture and possible pick-up of electrostatic charge. If package is punctured, re-moisturize pulp to at least 4% moisture before using.

## ***8. Exposure Controls/Personal Protection***

### **GENERALLY APPLICABLE CONTROL MEASURES AND PRECAUTIONS**

Use only with adequate ventilation. Avoid dust generation. Do not consume food, drink or tobacco in areas where they may become contaminated with this material.

### **ENGINEERING CONTROLS**

If fumes, fiber fly or dusts are generated, use engineering controls (where technically feasible) whenever necessary to control exposures below applicable limits. Isolation, enclosures, exhausts and ventilation, wetting and dust collection systems may be used.

If ventilation and exhaust air is recirculated, it should be filtered and conditioned to eliminate respirable fibers, dust and fumes. While HEPA filters are effective for dust removal from local

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exhausts, they have high pressure drops and require frequent maintenance. Larger airflow can be effectively cleaned of non-respirable fibers and particles by screens and coarse filter media. However, respirable particles can be removed only by secondary filtration equipment designed for fine particles (less than 10 micrometers aerodynamic diameter) or water curtains. Where respirable fibrils may be generated, recirculated air should be periodically measured to determine if they are being adequately removed. Air monitoring should be done using the standard asbestos test method, NIOSH 7400 (B). Method 7400(A) can also be used, counting only fibers less than 3 micrometers in diameter.

Fumes and smoke from laser cutting or machining of fabrics and composites of KEVLAR® should be well exhausted or removed by ventilation.

Water jet cutting of fabric or composites of KEVLAR® produces respirable size fibrils in the cutting waste. If dried, this waste can become a source of airborne respirable fibers. Rinse or wipe waste from floors, work surfaces and parts before it dries.

## PERSONAL PROTECTIVE EQUIPMENT

### RESPIRATOR PROTECTION

Respirator use must be in accordance with OSHA Standard 29 CFR 1910.134 (the "Respirator Standard").

Where airborne dust and fibril concentrations are expected to exceed applicable exposure limits, or where there is potential for irritation of the nasal passage by the mechanical action of the fibers, NIOSH-approved respirators should be used.

An air-purifying respirator with a dust/mist/fume cartridge or canister may be used under circumstances meeting the Respirator Standard.

Disposable dust masks equivalent to 3M model N95 8210 may also be used.

### EYE PROTECTION

Wear safety glasses or coverall goggles when cutting or mechanically working this product, or where airborne dust and fly is present.

### SKIN PROTECTION

When repeated forceful contact with KEVLAR® fiber structures is anticipated, wear protective gloves and sleeves to minimize skin abrasion and drying.

If repeated handling of KEVLAR® leads to dry skin, use non-greasy moisturizing skin cream. (Barrier creams are not recommended, as they may actually cause fiber dust to stick to the skin.)

## EXPOSURE GUIDELINES

Component	Exposure Guidelines			
	OSHA	ACGIH	DuPont	AIHA
	PEL	TLV®	AEL*	WEEL

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Poly (p-phenylenediamine terephthalamide)	None established	None established	2 fibrils/cc-8 hr. TWA, respirable fibrils**  5 mg/m <sup>3</sup> total dust	5 mg/m <sup>3</sup> 8 hr TWA total dust (non-respirable fibers and non-fibrous particles)
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\*AEL is DuPont's Acceptable Exposure Limit. Where governmentally imposed occupational exposure limits lower than the AEL are in effect, such limits shall take precedence.

\*\* Respirable fibrils are particles <3µm dia., 5-60µm long, with aspect ratios >3.

### 9. Physical and Chemical Properties

Melting Point:	Does not melt.
Water Solubility:	Insoluble in water.
Odor:	Odorless
Specific Gravity:	1.45 g/cc
Color:	Golden
Form:	Solid: Yarn, felt, fabric, paper, pulp, floc, staple
% Volatiles:	<9% water and finish. Wet pulp has <70% water.

### 10. Stability and Reactivity

Instability:	Stable at normal temperatures and storage conditions.
Incompatibility with Other Materials:	None reasonably foreseeable.
Decomposition:	Fiber decomposition temperature >400°C. At lower temperatures finish may boil off as a fume, which should be vented.
Polymerization:	Polymerization will not occur.

### 11. Toxicological Information

#### EYE EFFECTS

KEVLAR® is untested for eye irritancy. As with other particles, mechanical action of fibers in the eye may cause slight irritation.

#### SKIN EFFECTS

KEVLAR® fiber is not a skin irritant, or a skin sensitizer in animals. None of three tests using guinea pigs produced sensitization.

Skin sensitization has not been observed in human patch tests or in industrial experience. (KEVLAR® fiber has been used in direct contact with the skin in industrial gloves and protective apparel for many years.)

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The mechanical action of the fibers may cause slight skin irritation at clothing binding points. Repeated harsh rubbing of the skin with fibrous dust or supported KEVLAR® fiber structures (e.g., sized, coated or impregnated fabrics, paper edges, etc.) may cause abrasion, with resulting irritation and rash. Symptoms disappear following cessation of skin contact.

**ACUTE ORAL EFFECTS:**

KEVLAR® polymer has very low toxicity by ingestion. Oral ALD > 7500 mg/kg in rats.

**ACUTE INHALATION EFFECTS:**

Industrial experience shows that inhalation of KEVLAR® fibrous dust and fly may cause mechanical irritation of the mucous membranes of the nose and throat; these symptoms disappear upon cessation of exposure.

**SUBCHRONIC INHALATION EFFECTS:**

In a two week inhalation study with rats (1983), respirable KEVLAR® fibrils (subfibers) at concentrations of 1000-2000 fibrils per cubic centimeter (f/cc) caused mild, non-progressive fibrosis (lung scarring that shrinks with cessation of exposure) and nonspecific effects such as weight loss and irritation. There were no permanent lung effects at concentrations of 280 f/cc or less.

Two-week high-dose aerosol exposures to p-aramid fibrils in rats and hamsters produced transient pulmonary inflammatory and cell proliferative responses, along with evidence of progressive fiber biodegradability with increasing residence time in lung tissues of exposed animals. In both studies, the lungs of animals were analyzed at several post-exposure time periods ranging from immediately after exposure through one year post-exposure. Lung tissue thickening lesions in rats, which were measured morphometrically immediately after a 2-week exposure, had peaked at 1 month post-exposure and were reversible at 6 and 12 months post-exposure, i.e., no evidence of pulmonary lesions could be found 6 months after exposure.

**CHRONIC INHALATION EFFECTS:**

A two-year inhalation study with KEVLAR® pulp (refined to increase its respirable fibril content) produced pulmonary fibrosis at concentrations of 25, 100, and 400 f/cc, as well as additional lung lesions. A panel of 12 pathologists from North America and Europe reviewed these lesions and diagnosed them as "proliferative keratin cysts." They agreed that the lesions are not malignant neoplasms and are most likely not neoplastic. This unique lesion is not found in humans and may be indicative of a non-specific biological response to the respirable material, rather than an indication of the toxicity of KEVLAR®. No fibrosis was seen in animals exposed to 2.5 f/cc for two years (and very little at 25 f/cc.) At no concentrations were fibers found to have migrated beyond the lungs and associated lymph system. Four experiments at fibril concentrations of 2.5 f/cc to 400 f/cc have shown that KEVLAR® fibrils in the lungs of rats are shortened with time, probably by enzymatic clipping of the polymer chain. (This effect has been independently confirmed in rats by two other laboratories and in hamsters by DuPont. *In-vitro* tests show KEVLAR® fibrils are shortened in proteolytic enzyme solutions.) While not all fibrils disappear, long fibers are cut to an average of less than 5 micrometers and gradually removed. The lower the exposure, the faster fibrils are broken down.

**CARCINOGENICITY**

IARC (International Agency for Research on Cancer, the cancer research arm of the United Nations World Health Organization) completed an in-depth review of all valid scientific data relating to para-aramid fibrils in October, 1996. They classified the fibrils as in Group 3, "not classifiable as to their carcinogenicity to humans." That is, the experts found no convincing evidence of carcinogenicity. (While IARC has no regulatory authority, its expert opinions are used for guidance by regulatory authorities worldwide).



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#### SUMMARY

Industrial monitoring of airborne fibril concentrations indicates it would be unlikely that human exposures would approach levels that caused permanent health effects in animal studies. However, based on animal studies, long term exposures to high doses of respirable fibers could lead to pulmonary inflammation and subsequent development of chronic lung disease.

#### **MUTAGENIC, DEVELOPMENTAL AND REPRODUCTIVE EFFECTS:**

In an *in vitro* assay, KEVLAR® fibrils produced no chromosomal aberrations in cultural human peripheral blood lymphocytes.

No animal tests have been run to define mutagenic, developmental, or reproductive hazards.

### ***12. Ecological Information***

#### **ECOTOXICOLOGICAL INFORMATION**

KEVLAR® fibers are essentially non-biodegradable in the environment, and do not leach material toxic to flora or fauna.

Finishes and additives used with KEVLAR® are routinely tested for their potential effects on manufacturing wastewater treatment systems. Biocompatibility and aquatic toxicity tests give the following results:

- Finishes do not appear to be inhibitory or toxic to microbes commonly found in biological treatment systems.
- Biodegradation and normal anti-foam treatments should control foaming.
- Discharge of scoured finishes should not result in increased effluent toxicity.
- Most finishes are substantially or completely biodegradable, but a few are not.

Since concentrations and treatment conditions vary, the above should be considered indicative only.

### ***13. Disposal Considerations***

#### **WASTE DISPOSAL**

KEVLAR® fiber is not a hazardous waste as defined by regulations implementing the Resource Conservation and Recovery Act (RCRA). In general, waste materials of KEVLAR® may be treated, stored, transported and disposed of in accordance with the State and Local regulations governing the disposal of other common or non-RCRA regulated waste material.

Waste such as waterjet cutter sludge or dust from air filters may be enriched in respirable fibers. Bag securely, label as containing respirable fibers and dispose of it as non-hazardous industrial waste.

Since the fiber is essentially non-biodegradable, it should not be flushed to surface waters or sanitary sewer systems.

### ***14. Transport Information***

**DOT:** Proper Shipping Name: Not regulated

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**CANADA:** TDG CLASS: Not regulated

**ICAO:** International Civil Aviation Organization classification not required

**IMDG:** International Maritime Dangerous Goods classification not required

### ***15. Regulatory Information***

#### **U.S. FEDERAL REGULATIONS**

**OSHA:**

This MSDS is provided to comply with provisions of the Hazard Communication Standard (29 CFR 1910.1200).

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**EPA:**

TSCA: KEVLAR® fiber products are listed on the TSCA Inventory.

CERCLA: KEVLAR® is not regulated as hazardous waste under CERCLA.

SARA TITLE III, Section 313: Not reportable.

**CLEAN AIR ACT AMENDMENTS OF 1990:**

KEVLAR® fiber products and their packaging do not contain, nor are they manufactured with, any of the ozone-depleting substances listed in either Class I (chlorofluorocarbons, halons, carbon tetrachloride, and methyl chloroform) or Class II (hydrochlorofluorocarbons) of the Clean Air Act Amendments of 1990.

**FDA:**

Some, but not all, KEVLAR® fiber products are approved for use as articles or components of articles intended for repeated contact with food. (See **CFR 21**, Part 177.1632, 4/1/92 Edition.)

**STATE REGULATIONS****California Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65):**

KEVLAR® fiber contains none of the substances known to the State of California to cause cancer or reproductive toxicity.

**Pennsylvania and New Jersey Right-to-Know Laws:**

KEVLAR® fiber is considered an "article" and is not subject to the provisions of the Pennsylvania and New Jersey Right-to-Know laws.

**CANADA REGULATIONS**

This material is not WHMIS controlled.

This material is not TDG regulated.

**16. Other Information****CAUTION:**

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

**NFPA Ratings**

Health 0  
Flammability 1  
Reactivity 0

**NPCA-HMIS Ratings**

Health 0\* (chronic health effects)  
Flammability 1  
Reactivity 0

**REFERENCES:**

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**NOTE:**

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. The MSDS format adheres to U.S. standards and regulatory requirements and may not meet regulatory requirements in other countries. This information is based upon technical information believed to be reliable. It is subject to revision as additional knowledge and experiences are gained. This replaces all previous MSDS versions for the listed products.

**RESPONSIBILITY FOR THIS MSDS:**

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**End of MSDS**