



Elvanol<sup>®</sup>  
polyvinyl alcohol



**WARP SIZING WITH DUPONT**  
**ELVANOL<sup>®</sup> T-GRADES**

*ELVANOL*® T-Grades of polyvinyl alcohol are unique copolymers developed especially for use as warp sizes for polyester/cotton blends and other spun yarns. Alone or in combination with starch and additives, *ELVANOL*® T-Grades are being used successfully on practically every type of spun yarn now on the market, including acetate, acrylic, cotton, rayon, wool, nylon, and polyester spuns and such blends as polyester/cotton, polyester/wool, and polyester/rayon.

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# ADVANTAGES OF ELVANOL® T-GRADES

Size bath formulas based on *ELVANOL*® T-Grades are simple and easy to prepare, and run without difficulty on the slasher. Important performance advantages of the *ELVANOL*® T-Grades as a warp size include the following:

## LOW ADD-ON

The high film strength, abrasion resistance, and excellent adhesion of *ELVANOL*® T-Grades permit their use at about one-third to one-half of the add-on required with starch formulas. Since lower add-on and higher adhesion results in less shedding on the loom, less frequent cleaning of drop wires, heddles, and reeds is required. Reduced add-on also permits greater warp yardage per beam, with consequently fewer doffs at the slasher and fewer tie-ins at the looms. This in turn means increased production at lower labor costs. "Tight" constructions are easier to weave at low size add-on, as there is more air space in the reed. Finally, the lower weight of size present reduces freight costs on shipments of grey cloth to finishing mills.

## HIGH WEAVING EFFICIENCY

Yarns sized with *ELVANOL*® T-Grades show excellent weaving performance with few loom stops. Good hairiness reduction results in low warp-related filling stops on air jet looms.

## LOW WEAVE-ROOM HUMIDITY

Weaving efficiency remains high over a wide range of humidities as *ELVANOL*® T-Grades remain flexible at low humidity, and is not softened at higher humidities. High humidity is not required for good weaving performance. Consequently, a more comfortable working atmosphere can be maintained without sacrificing efficiency. Lower humidity also prolongs the life of loom parts that are subject to corrosion in moist atmospheres.

## EXCELLENT SIZE BATH STABILITY

Solutions of *ELVANOL*® T-Grades are non-corrosive and are not subject to spoilage. Unlike starch sizing materials, they can be held at elevated temperatures for days without viscosity degradation. There is no need to heat pipelines to prevent gelling of the size solution.

## EASE OF DESIZING

*ELVANOL*® T-Grades dissolve readily in hot water, without the need for costly enzymes. They are easily removed, even from heat-set polyester/cotton fabrics. Film dissolution studies show *ELVANOL*® Grades T-66 and T-91 to exhibit better dissolving characteristics than medium or high viscosity partially hydrolyzed grades at 140-160°F (60-71°C), particularly in the presence of mild caustic (often added in cloth preparation).

## ENVIRONMENTALLY FRIENDLY

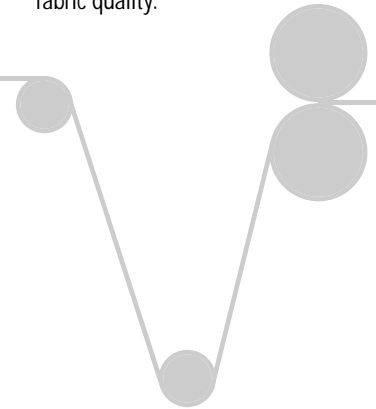
*ELVANOL*® T-Grades have low Biological Oxygen Demand (BOD) compared to many other sizes. Combined with the ability to weave efficiently with low add-on, this results in a low BOD and COD (Chemical Oxygen Demand) in the desize stream to a finishing mill's waste water treatment plant or Publicly Owned Treatment Works (POTW). *ELVANOL*® copolymers are degradable in properly designed and operated activated sludge waste water treatment systems. When a size recovery system is installed at the desize stage, virtually all *ELVANOL*® is eliminated from the waste water.

## ECONOMICALLY RECOVERABLE AND REUSABLE

The unique molecular structure of the *ELVANOL*® T-grade copolymers is extremely chemically stable, and is not hydrolyzed or otherwise chemically altered in the heat and stresses of a size recovery system. The T-grades are easily recovered and reused in any type of commercially available ultrafiltration system. Reuse is straightforward, as there is no viscosity change during desizing, ultrafiltration, or storage. Higher concentrations can be achieved, reducing transportation costs and providing maximum flexibility in reuse of the reclaimed solutions.

## FAVORABLE COST/PERFORMANCE

The foregoing advantages make the overall cost/performance of warp sizes based of *ELVANOL*® attractive, particularly for polyester blend yarns where starch based sizes do not perform well at the low add-on required to achieve fabric quality.



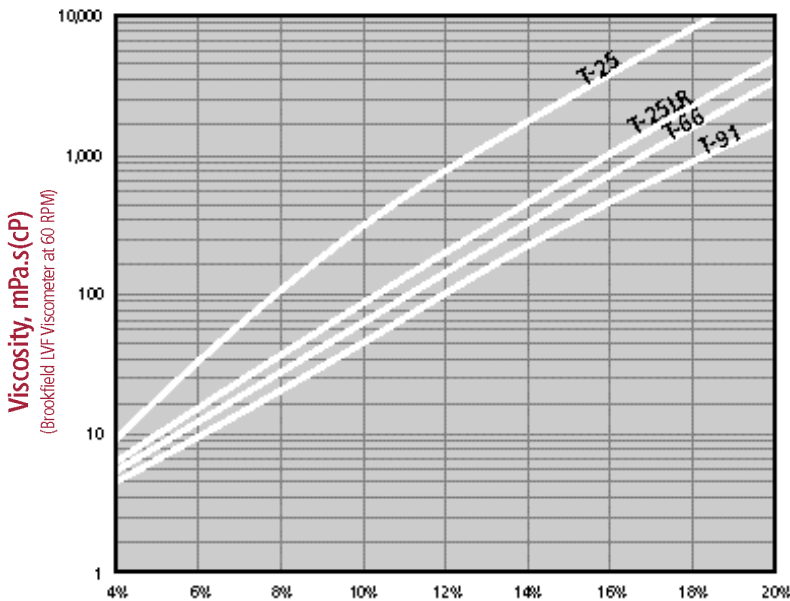
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*ELVANOL*® T-Grades are unique copolymer polyvinyl alcohols designed specifically for use as a warp size for spun yarns. Supplied as white, granular solids, they slurry easily in cold water without lumping and dissolve readily on heating.

## SHIPPING & STORAGE

*ELVANOL*® polyvinyl alcohol is packaged in 50 lb (22.7 kg) net multiwall paper bags. Bag shipments are available on request in 2,250 lb (1,021 kg) unitized loads on nonreturnable pallets. In addition, Supersack shipments of 1,050 lb (500 kg) on nonreturnable pallets are also available. For bulk handling, *ELVANOL*® can also be delivered by hopper car or hopper truck (tariff minimum quantities). The bulk density of *ELVANOL*® is somewhat lower than that of starch (24-27 lb/cu ft for *ELVANOL*® vs about 44 lb/cu ft for starch). Bulk storage and handling facilities designed for starch can generally be used with

**FIGURE 1**  
Effects of Concentration on Viscosity of *ELVANOL*® at 160°F



% *ELVANOL*® in Solution

little or no modification for handling *ELVANOL*®. For further information, see product bulletins or call or write your nearest DuPont *ELVANOL*® representative.

*ELVANOL*® as supplied can be stored indefinitely without lumping, molding, or deteriorating.

Since solutions of *ELVANOL*® T-Grades do not gel or mold, they can be stored over weekends and shutdown periods without impairing their usefulness. Solutions of *ELVANOL*® are stable, noncorrosive, and nontoxic.

*ELVANOL*® T-Grades of polyvinyl alcohol can be used alone or in combination with starches and additives, depending on the yarn and weave and on individual mill preference. Its applications range from a 100% PVA single component size for polyester, to 50-75% PVA/starch blends for polyester/cotton blends, to 50% PVA/starch blends for cotton to use as a binder in 10-15% PVA/starch blends for denim and towel pile formulations. As a single-component size, polyvinyl alcohol is effective at low add-on for use with the entire spectrum of spun yarns being woven today, including natural, synthetic, and blend yarns such as polyester/cotton spun blends. The low add-on at which *ELVANOL*® can be applied as a single component size is particularly advantageous for tight fabric constructions that are difficult to weave. In combinations with starch, *ELVANOL*® improves the strength of the size film and provides the required adhesion to synthetic yarns. Table I suggests concentration ranges for initial trial in applying *ELVANOL*® alone to typical spun yarns. Wet size pickup will generally be in the range from 100-130% for polyester/cotton blends, but will vary from mill to mill depending on equipment and operating conditions used, e.g., squeeze roll pressure, squeeze roll hardness, and slashing speed.

Because of the wide variation in fiber combinations, yarn count and twist, fabric construction, and slasher conditions, the formulas in Table I are useful only as a general guide. For kettle formulas suitable for your specific yarn and fabric constructions and mill conditions, consult your DuPont *ELVANOL*® representative or write the nearest office listed on the back cover.

**TABLE I**  
**Guide for Sizing Spun Yarns**  
**with *ELVANOL*® T-Grades**

Yarn	Size Solution Solids(%)
Dacron® polyester/cotton Fine Count- 40/1 to 50/1	8-10
Medium count- 20/1 to 30/1	6-8
Dacron® polyester/rayon Medium count- 20/1 to 30/1	6-8
Dacron® polyester/wool	6-8
Cotton Fine count- 40/1 to 50/1	8-10
Medium count- 20/1 to 30/1	6-9
Viscose® rayon	3-5
Acrylic Medium count	8-11
Nomex® nylon	9-11
Tencel®	7-9

The addition of 5-8% (on weight of *ELVANOL*®) of a low melting point, emulsifiable wax is generally recommended.

*ELVANOL*® polyvinyl alcohol disperses smoothly in cold water and dissolves readily on heating. Size baths based on *ELVANOL*® alone or in combination with starch are easily prepared in all types of equipment now being used for size preparation.

## CLEANING OF EQUIPMENT

Clean the dissolving equipment, pumps, pipelines, and size boxes thoroughly with hot water before dissolving and applying size formulas based on *ELVANOL*®. Inorganic salts, soaps, alkalies, and cleaning powders may increase solution viscosity and precipitate the *ELVANOL*®. Borax, an ingredient of many soaps and cleaning powders, is especially harmful since it causes gelation of polyvinyl alcohol solutions if present even in low concentrations.

## SIZE PREPARATION

- Add cold water (less than 85°F) to cooking kettle. All of the water should be added before adding solid materials.
- Start the agitator and circulating pump.
- Add the proper amount of *ELVANOL*®.
- Add the proper amount of starch and other dry ingredients.
- Add the proper amount of wax.
- Inject live steam to raise temperature to 180-210°F (80-99°C) and stir at this temperature for 20-30 minutes. If starch is present, temperature should be 190-210°F (85-99°C). Stir for 30 to 45 minutes.
- Add any liquid binders as appropriate.
- Stir for 2-3 minutes.
- Check final solids and viscosity, and add water to adjust as needed.

Established slasher practices can be followed in applying sizes based on *ELVANOL*® T-Grades.

## SIZE BOX TEMPERATURE

Temperatures of 150-175°F (66-79°C) give best results with size formulations based on *ELVANOL*® alone. This range is high enough to give satisfactory penetration. At the same time, it is low enough to prevent skinning or film formation on the bath surface during “creep” speed operation of the slasher.

Spun-yarn sizing formulations containing combinations of *ELVANOL*® T-Grades with modified starches have higher solids contents and higher viscosities. As with other starch formulas, size box temperatures around 180-200°F (80-94°C) are necessary to maintain workable viscosities and obtain satisfactory penetration.

## SQUEEZE ROLL PRESSURE

Normal squeeze roll pressures are usually satisfactory. The amount of size pickup can be varied by changing the squeeze roll pressure.

## DRYING CANS

For spun yarns, the first drying can should be operated at 220°F (104°C) or perhaps higher to prevent can sticking and film formation. Yarn temperatures above 280°F (138°C) should be avoided. In general, the drying can temperatures should be set at the minimum required to dry the yarns to the final moisture content desired for the particular yarn being sized. Automatic moisture-control instruments work very satisfactorily with warps sized with *ELVANOL*® polyvinyl alcohol. If a double size box is used, it is desirable to dry the sheds separately over at least three or four drying cans. This dries the yarn sufficiently to prevent cementing together when the sheds are joined. Adequate preliminary drying of each shed ensures an easy separation (or break of the yarns at the bust bar and lease rods). It is recommended that the dry cans be coated with Teflon® TFE fluorocarbon resin to prevent can sticking.

## STRETCH

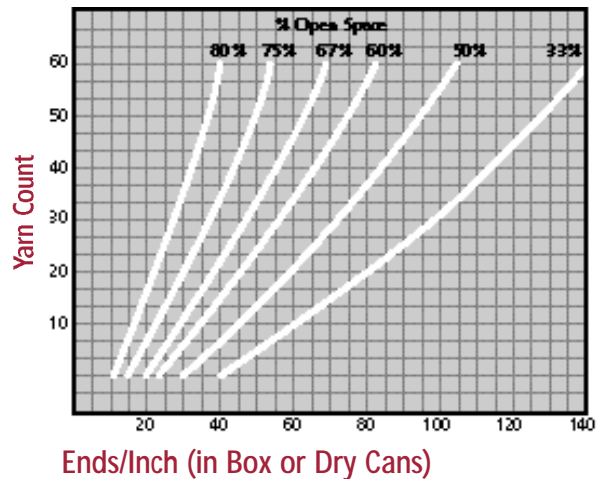
Stretch should be controlled for the yarn being sized. Most cotton and polyester/cotton blends will be 0.8-2.0% total stretch. Other yarn types will vary. An even tension should be maintained from section beam to section beam.

## WARP DENSITY

Proper spacing between individual warp yarns in the size box is important for optimum pickup of size. Adjacent ends should be separated by a space approximately equal to the yarn diameter.

On the dry cans, a minimum of 75% open space is recommended for Air-Jet weaving. It is preferable to use a multiple size box or wet split if available to permit maximum separation (Refer to Fig. 2).

FIGURE 2  
Size Box Warp Density vs Yarn Count



Ends/Inch (in Box or Dry Cans)

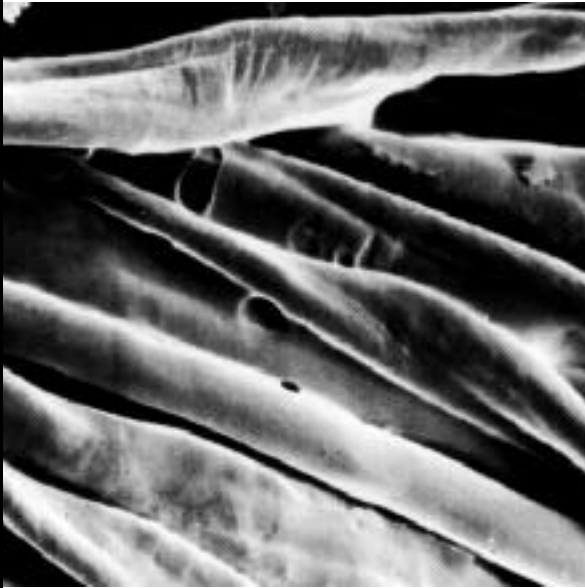


PHOTO Size: ELVANOL® T-25 polyvinyl alcohol (570X)



PHOTO Size: Modified Pearl Starch (510X)

## SPACE BETWEEN ENDS

% Open Space      Number of Yarn Diameters

33	1/2
50	1
60	1 1/2
67	2
72	2 1/2
75	3
78	3 1/2
80	4

ELVANOL® T-Grades adhere without flaking to both polyester and cotton fibers. The fiber bundle is cemented together and encapsulated with size to achieve the abrasion resistance required on the loom. (Please see photos to the left).



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## WEAVING SIZED YARNS

Warps sized with *ELVANOL*® T-Grades of polyvinyl alcohol show excellent weaving performance and are especially advantageous for “tight”, difficult-to-weave constructions. Normal loom settings and regular weave room procedures can be followed.

## WEAVE ROOM HUMIDITY

Warps sized with *ELVANOL*® do not require the high weave room humidities necessary for handling starch sized yarns. Humidity may be reduced to 60-75%<sup>5</sup> R.H. or even lower if desired, to provide more comfortable working conditions and reduce maintenance costs on loom parts that are sensitive to humidity. Since high humidity does not affect the performance of *ELVANOL*®, customary settings can be maintained during changeover and the humidity reduced after conversion to yarn sized with *ELVANOL*®.

## SIZED YARN PROPERTIES

The superior adhesion of *ELVANOL*® as compared with starch is apparent from the stereo-scan electron micrographs on page 8. The adhesion, toughness, and film strength of *ELVANOL*® are reflected in improved physical properties of the sized yarn. Table II shows the effect of size on a typical polyester/cotton blend yarn to be woven into a 128 sley broadcloth. *ELVANOL*®, at half the total add-on required with starch, produces a stronger yarn with 25% greater elongation and lower stiffness (modulus). The improved toughness of the yarn sized with *ELVANOL*® is indicative of good flex life, abrasion resistance, and shock absorbency on the loom.

TABLE II

Effect of Size on Yarn Properties (Dacron® Polyester/Cotton, 65/35 Blend)

Property	Sized Yarn		
	<i>ELVANOL</i> ® T-25	Starch <sup>1</sup>	Unsize Yarn
Size Add-On, %	10	20	0
Yarn Count <sup>2,3</sup>	48.0	46.0	48.8
Breaking Strength <sup>2, 4</sup> , g (mN)	220 (2160)	210 (2060)	190 (1865)
Elongation at Break <sup>2,4</sup> , %	10	8	15
Modulus <sup>2</sup> , g/denier (g/dtex <sup>5</sup> )	37 (33.3)	42 (37.8)	25 (22.5)
Toughness <sup>2</sup> , g-cm/den cm (g-cm/dtex-cm)	0.10 (0.09)	0.08 (0.072)	0.09 (0.081)

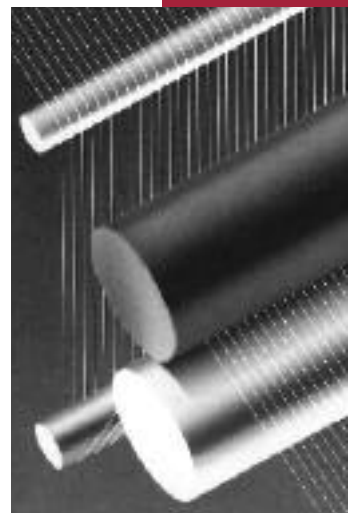
<sup>1</sup>Pearl starch plus binders and waxes amounting to 22% on weight of starch.

<sup>2</sup>Tested at 70°F (21°C), 65% R.H.

<sup>3</sup>ASTM D1907-69.

<sup>4</sup>ASTM D2256-69.

<sup>5</sup>Denier x 1.111 = decitex (dtex)



## DESIZING

*ELVANOL*® T-Grades are readily removed in hot water at flow rates that effectively remove starch. No enzymes are required unless starch is also present. Even after polyester/cotton fabric have been heat-set in the greige, *ELVANOL*® T-Grades of polyvinyl alcohol are readily removed.

## WASH CONDITIONS

Cloth sized with *ELVANOL*® T-Grades is readily desized in standard open-width or rope washers. Water temperature, the number of washes, and the ratio of wash liquor to goods are all important in obtaining complete size removal. The higher the temperature, the more rapidly and completely any polyvinyl alcohol size is removed. Wash box temperatures of 160-210°F (71-100°C) are suitable for removing *ELVANOL*® T-Grades, depending on fabric construction and equipment limitations. The more wash boxes and the higher temperatures used, the more rapidly and completely the size is removed. Generally, a greater number of wash boxes will be required when operating at lower temperatures. Wetting agents and chemical agents such as soda ash or hydrogen peroxide may be added to the wash liquor if desired to increase the rate of solution of polyvinyl alcohol sizes. Liquors containing 8% or more caustic are not recommended for desizing since the polyvinyl alcohol, although dislodged from the fabric, remains suspended as a gelatinous mass which still requires a hot wash for removal. After a fabric has been desized with water, it can be given a conventional caustic scour before bleaching.

## ENZYMES

The enzymes used in removing starch sizes, and also *ELVANOL*® polyvinyl alcohol/starch combinations, have no effect on polyvinyl alcohol. They neither facilitate nor interfere with removal.

## STEAMING

Steaming the cloth before it enters the washer softens the polyvinyl alcohol size film so that it is more easily penetrated and dissolved by water. The cloth needs to remain in the steamer only long enough to reach equilibrium with the temperature in the chamber.



## TYPICAL DESIZING EXAMPLES

### 100% Polyvinyl Alcohol Size

Pad on solution (160-180°F) containing:

Surfactant

Sodium Hydroxide (NaOH) if desired (up to 5% concentration)

or Hydrogen Peroxide (H<sub>2</sub>O<sub>2</sub>) if desired (0.25 to 1.0% concentration)

Hold in steamer or J-Box: 2 to 5 minutes

Several washers at 160-210° F (the hotter, the better)

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For size recovery systems, no chemicals should be added to the pad.

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### Polyvinyl alcohol/Starch blends

Oxidative Desize

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Pad on solution (160-180°F) containing:

Detergent (0.3%)

Sequestrant (0.1%)

Sodium Hydroxide (NaOH) (0.7-2.0% concentration)

Hydrogen Peroxide (H<sub>2</sub>O<sub>2</sub>) (0.2-0.4% concentration)

Salt (0.04%)

Emulsifiers as needed

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Hold in steamer or J-Box: 2 to 5 minutes

Several washers at 160-210°F (the hotter, the better)

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### Enzyme Desize

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Pad on solution (120-160°F) containing:

Amylase Enzyme (1-2%)

Detergent (0.3%)

Salt (1-2%)

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Dwell time in steamer or J-Box: 2 to 5 minutes; cold 30 minutes (minimum)

Several washers at 160-210°F (the hotter, the better)

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Due to the variety of fabrics and desizing equipment, these conditions are to be considered general in nature. Specific discussions with *ELVANOL*<sup>®</sup> representatives or your finishing chemical supplier are always recommended.

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## SPOT TEST

DuPont has developed spot test procedures for polyvinyl alcohol to be used on desized goods. A copy of the procedure and a color chart may be obtained by requesting publication E-74719-1 and color guide.

## GENERAL

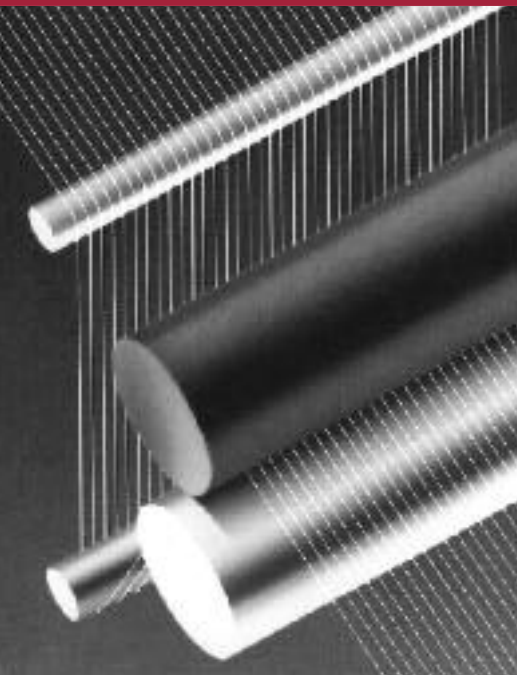
### WASTE DISPOSAL

*ELVANOL*<sup>®</sup> polyvinyl alcohol in solution or granular form can be disposed of by incineration or landfill. Any disposal procedure however, must comply with federal, state and local regulations. When exposed to nonacclimated domestic sludge microorganisms, *ELVANOL*<sup>®</sup> has a low biochemical oxygen demand for periods up to thirty days. Recent work has shown:

- Domestic and textile mill activated sludge microorganisms can acclimate to *ELVANOL*<sup>®</sup> polyvinyl alcohol under conditions attainable in conventional waste treatment systems.
- Greater than 90% removal of *ELVANOL*<sup>®</sup> from textile mill wastes can be achieved in activated sludge waste treatment systems that contain acclimated microorganisms. For more detailed information on the biodegradation of *ELVANOL*<sup>®</sup>, contact your DuPont representative for a copy of DuPont Technical Report E-08234-1 (Biodegradation Rates of *ELVANOL*<sup>®</sup> PVOH).

### SAFE HANDLING

*ELVANOL*<sup>®</sup> polyvinyl alcohol can be safely handled in a properly designed bulk silo. Contact your DuPont representative for a copy of the DuPont technical report, "Bulk Storage & Safety Handling Guide." *ELVANOL*<sup>®</sup> polyvinyl alcohol is a safe material when properly handled. Polyvinyl alcohol is not a primary skin irritant and does not produce skin sensitization. Extensive tests made with *ELVANOL*<sup>®</sup> indicate a very low order of toxicity when administered orally to laboratory animals. When polyvinyl alcohol is injected under the skin or into the lungs, it is not broken down by the tissues but remains as a foreign body. Under certain conditions of use, dust may be formed from *ELVANOL*<sup>®</sup> polyvinyl alcohol. DuPont recommends that dust from *ELVANOL*<sup>®</sup> be treated as a nuisance dust, which is regulated by OSHA under Title 29, Code of Federal Regulations, Section 1910.1000. Under this section, an employee's exposure to nuisance dust shall be limited to 10 milligrams per cubic meter (mg/m<sup>3</sup>) of total dust and 5 mg/m<sup>3</sup> of respirable dust on a time-weighted average in any eight-hour shift of a forty-hour week. If excessive concentrations of dust are encountered, a mask or respirator, complying with Section 1910.134 of the OSHA regulations, should be worn. Goggles should comply with Section 1910.133.



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