

## SECTION III: HOME LAUNDERING GARMENTS OF NOMEX® ARAMID FIBER

### GENERAL GUIDELINES

Garments of NOMEX® can be washed and dried by any conventional home method, followed by hand ironing if necessary. No special technology is needed for home laundering garments of NOMEX®. However, home procedures may not remove the last traces of very heavy, widespread or ground-in soils, which may be flammable and could adversely affect the thermal protective performance of garments of NOMEX®.

If home laundering does not remove contaminants or contaminant build-up, garments can be periodically dry cleaned or commercially laundered. When garments are contaminated by hazardous materials, only commercial or on-site laundering or dry cleaning should be used with the appropriate wastewater treatment techniques.

The following procedures can help provide optimum cleaning:

#### *Sorting*

Garments of NOMEX® should be sorted and washed separately from other garments to prevent contamination with lint of flammable fibers.

#### *Pretreating*

Stains, as well as deep soil lines on the collars and cuffs of garments, are more readily removed if pretreated. Stains should be pretreated at the earliest opportunity and sufficient time allowed for the pretreatment material to penetrate and loosen the soil. The heavily soiled or stained areas should be rubbed with a full-strength, heavy-duty liquid detergent or any off-the-shelf laundry pretreatment product.

#### *Preparing the Wash Load*

Before laundering garments of NOMEX®, pockets should be emptied, pants cuffs cleaned out and zippers closed.

#### *Load Size*

When laundering garments of NOMEX®, it is important not to overload the machine. To ensure a cleaner wash and avoid setting wash wrinkles, the load size must permit clothes to move freely through the wash water and rinse cycle. Regardless of the machine's rated capacity in pounds, bulk — not weight — should be the limiting factor.

#### *Wash Water Temperature*

Moderate soil levels may be removed adequately at normal wash water temperature settings. Heavily soiled and stained garments of NOMEX® require a higher water temperature setting.

#### *Detergents*

Synthetic, heavy-duty liquid laundry detergents are recommended for washing garments of NOMEX®. These "designed" products do a superior job of removing soils and are less likely than soap to form sticky deposits of lime soap curds, which are difficult to rinse out. Fatty-based soaps should not be used. Under-use of detergent results in poor soil removal and frequently causes suspended soils to redeposit on the clothes. Failure to use a sufficient amount of detergent is the single greatest cause of inadequate home cleaning.

#### *Water and Water Conditioners*

For best results, an adequate supply of "soft" water is required for home laundering garments of NOMEX®. "Hard" water contains minerals, such as calcium and magnesium salts, that combine with fatty-based soaps to form insoluble film, scum or curd. These insoluble contaminants are difficult to rinse from fabrics, may be flammable and could adversely affect the thermal protective performance of garments if not adequately removed. Soap is not recommended, but if it is used in hard wash water (more than approximately 7 grains/gal., 120 mg/L or 120 ppm), a nonprecipitating-type water conditioner should be added. Softening the water reduces soap consumption and improves the quality of washing.

### *Bleaches*

Only oxygen-based bleaches should be used on garments of NOMEX® — *chlorine bleach should not be used*. Although chlorine bleach will not affect the inherent flame resistance of NOMEX®, it may cause strength and color loss in garments over time.

### *Fabric Softeners and Anti-Stats\**

Under normal conditions, garments of NOMEX® IIIA do not require the use of anti-stats because NOMEX® IIIA contains a proprietary static-dissipative fiber. Nevertheless, numerous washer- and dryer-applied fabric softeners are available for use in home laundry equipment. These products improve the “feel” of items of NOMEX® and can reduce the nuisance effects of static electricity — such as lint pick-up and clinging — that are often experienced with textiles. However, they are not as effective as industrial anti-stats applied in the wash wheel.

**NOTE:** Anti-static additives cannot ensure safety in situations where a discharge of static electricity could create a potential hazard to life or property. If garments of NOMEX® will be worn in an area where explosive or highly flammable materials are present, it is important that personnel and equipment be properly grounded for maximum safety.

### *Tumble Drying*

Garments of NOMEX® will have a smoother appearance when tumble dried instead of being line or drip dried. To ensure maximum removal of wrinkles, tumble dryers should not be overloaded.

Drying time varies with the nature and size of the load. Garments of NOMEX® dry faster than all-cotton garments of the same weight. When tumble dried at the medium- or high-temperature setting, a properly sized load usually dries in approximately 20 minutes.

Machines designed to give the best automatic wash-and-wear or durable-press performance are programmed so that the blower fan and clothes drum continue to operate five to 10 minutes after the heater turns off. This provides a cool-down period for the garments and helps minimize wrinkles. Tumble dryers with this capability usually feature a control dial or push button with a “Wash-and-Wear” or “Durable Press” setting that provides the proper temperature and a cool-down cycle.

### *Ironing*

If garments of NOMEX® need touch-up pressing, a steam or dry iron may be used at the medium setting.

\*Most dryer sheet and some liquid fabric softener products contain disclaimers from the manufacturer stating their product should not be used on children's sleepwear or FR garments. If used in home laundry applications, products with no disclaimer should be selected.

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## SECTION IV: DRY CLEANING

### GARMENTS OF NOMEX® ARAMID FIBER

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#### GENERAL GUIDELINES

There are times when dry cleaning garments of NOMEX® is desirable for economic reasons or because greases and oils cannot be adequately removed during home or commercial laundering. Garments of NOMEX® can be satisfactorily dry cleaned in any conventional commercial dry-cleaning system. With heavily soiled garments, using a two-bath cycle may improve soil removal and minimize redeposition. Garments of NOMEX® should be cleaned separately from articles of other materials to avoid contamination with lint of flammable fibers. The practice of maintaining a clean solvent supply must be observed.

No special technology exists for applying anti-stat treatments to garments of NOMEX® during dry cleaning. Some suppliers to the dry-cleaning industry offer anti-stat treatments for dresswear that also can be used with uniforms of NOMEX®. If equipment is available, dry-cleaned garments of NOMEX® also can be treated with AVITEX® DN softener from a water solution, as described in the commercial laundering section of this bulletin.

## SECTION V: REMOVING SPOTS AND OTHER NON-STANDARD CONTAMINANTS FROM GARMENTS OF NOMEX® ARAMID FIBER

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### GENERAL GUIDELINES

Properly dyed and finished garments of NOMEX® are flame resistant. However, flame resistance can be compromised by the presence of flammable contaminants on the garment, or on the fabric from which it is made. Paint, heavy oily soils or other flammable materials encountered in an industrial environment can pose a hazard if not removed from the garment. In addition, these contaminants are unsightly and detract from the professional appearance of a high-quality garment.

For work assignments where employees are routinely exposed to paint, epoxy or other difficult- or impossible-to-remove contaminants, the use of flame-retardant disposable coveralls as overgarments should be considered. This will minimize the cleaning task and prolong the life of the garment of NOMEX®. When accidental exposures occur, the contaminant should be removed as soon as possible before it sets in or dries. And, the contaminated garment should be clearly identified so the cleaning facility can spot clean the garment before routine laundering or dry cleaning.

The NOMEX® fiber is resistant to most chemicals typically used to launder, dry clean or spot clean garments, including special laundry detergent/solvent emulsifier formulations designed to remove paint, tar, adhesives and other difficult-to-clean stains. These special formulations can be used as either spot cleaners or as laundry or dry-cleaning additives. As an added precaution, they should be checked for compatibility with fabric of NOMEX® before any contaminant removal is attempted. The chemical supplier's spotting and cleaning procedure recommendations should be followed.

Because these formulations may contain flammable solvents, garments should be cleaned by standard cleaning methods after spot cleaning. When chemical additives are used in laundering or dry cleaning, garments should be thoroughly rinsed to ensure the removal of any residual flammable solvents.

Several technical bulletins describing the resistance of NOMEX® to various chemicals are available through the DuPont Product Information Center (800-441-7515) or the DuPont Aramids Telemarketing Group (800-453-8527).

**APPENDIX I: SOURCE LIST FOR LAUNDERING PRODUCTS\***

Product/Trademark	Detergent Vendor
<b>Alert</b>	<b>Ecolab, Textile Care</b>
<b>Dynalite/Force</b>	370 Wabasha Street
<b>Innovator Ultra Liquid</b>	St. Paul, MN 55102
<b>Innovator Ultra Powder</b>	(800) 553-8683
<b>Factor Plus®</b>	<b>Diversity Fabrilife</b>
<b>Liquid Factor® I</b>	4480 Lake Forest Drive
<b>Liquid Factor® II</b>	Cincinnati, OH 45242
	(800) 862-8883
<b>Surpass 2</b>	<b>U.N.X., Inc.</b>
	P.O. Box 7206
	Greenville, NC 27835-7206
	(919) 756-8616
<b>Choice</b>	<b>Washing Systems, Inc. (WSI)</b>
	1865 Summit Road
	Cincinnati, OH 45237
	(800) 272-1WSI (272-1974)

Product/Trademark	Softeners/Anti-Stats Vendor
<b>AVITEX® DN</b>	<b>DuPont Company</b>
	Specialty Chemicals
	1007 Market Street
	Wilmington, DE 19898
	(800) 441-9442

Product/Trademark	Antifoams Vendor
<b>Dow Corning®</b>	<b>Dow Corning</b>
<b>Antifoam 1430</b>	PHAC Customer Service
	P.O. Box 0994
	Midland, MI 48686-0994
	(800) 362-6373

Product/Trademark	Water/Oil Repellents Vendor
<b>Winsol® Fireline</b>	<b>Winsol Laboratories</b>
<b>Water Repellent</b>	1417 N.W. 51st Street
	Seattle, WA 98107
	(800) 782-5501
<b>ZONYL® 6991</b>	<b>DuPont Company</b>
	Specialty Chemicals
	1007 Market Street
	Wilmington, DE 19898
	(800) 441-9442

**NOTE:** Listing of products in this appendix does not indicate a DuPont endorsement. Other products not listed in this appendix also may be acceptable laundering products for garments of NOMEX® aramid fiber. Other products that have not been tested but that belong to the same class of low temperature, low alkalinity, high surfactant-based products also may provide acceptable results.

## APPENDIX II: SUGGESTED WASH PROCEDURE FOR LIGHTLY SOILED GARMENTS OF NOMEX® ARAMID FIBER\*

Operation	Water Level, in. (cm)	Water Temp., F (°C)	Time, min.	Supplies**/100 lb (45 kg) of Garments
Break	6 (15)	140 (60)	15	2.5 lb (1.1 kg) recommended detergent
Rinse	10 (25)	140 (60)	3	
Rinse	10 (25)	135 (57)	3	
Rinse	10 (25)	120 (49)	3	
Rinse	10 (25)	105 (41)	3	
Rinse	10 (25)	90 (32)	3	
Sour	6 (15)	Cold	10	1-4 oz. ammonium silicofluoride
Softener/Anti-Stat (optional)				AVITEX® DN***

\*Load wheel to ¾ of its rated capacity.

\*\*See Appendix I for laundry supplies.

\*\*\*If used, apply 0.50% to 0.75% on weight of dry fabric, as described in text and Appendices IV and V.

**APPENDIX III: SUGGESTED WASH PROCEDURE FOR HEAVILY SOILED GARMENTS OF NOMEX® ARAMID FIBER\***

Operation	Water Level, in. (cm)	Water Temp., F (°C)	Time, min.	Supplies**/100 lb (45 kg) of Garments
Break	6 (15)	160 (71)	20	2.5-3 lb (1.1-1.4 kg) recommended detergent
Flush	8 (20)	160 (71)	3	
Suds	6 (15)	160 (71)	10	1.25-1.5 lb (0.5-0.7 kg) recommended detergent
Rinse	10 (25)	160 (71)	3	
Rinse	10 (25)	160 (71)	3	
Bleach	10 (25)	150 (66)	5	oxygen-based bleach only
Rinse	10 (25)	150 (66)	3	
Rinse	10 (25)	135 (57)	3	
Rinse	10 (25)	120 (49)	3	
Rinse	10 (25)	105 (41)	3	
Sour	6 (15)	Cold	10	1-4 oz. ammonium silicofluoride
Softener/Anti-Stat (optional)				AVITEX® DN™

\*Load wheel to ¾ of its rated capacity.

\*\*See Appendix I for laundry supplies.

\*\*\*If used, apply 0.50% to 0.75% on weight of dry fabric, as described in text and Appendices IV and V.

## APPENDIX IV: APPLICATION OF AVITEX® DN SOFTENER/ANTI-STAT

### Definitions

• **Add-On** — The calculated percentage of AVITEX® DN added to the dry weight of the goods. (AVITEX® DN is not substitutive to NOMEX® aramid fiber. This calculation assumes that none of the “as received” formulation is lost due to evaporation during the drying cycle.)

• **Wet Pickup** — The percentage of liquid<sup>1</sup> carried by the goods that contains AVITEX® DN after the final cycle of the wash wheel.

$$\% \text{ Wet Pickup} = \frac{\text{wet weight} - \text{dry weight}}{\text{dry weight}} \times 100$$

• **Solution Concentration** — The percentage of AVITEX® DN in the final cycle of the wash wheel.

$$\% \text{ Solution Concentration} = \frac{\text{AVITEX}^{\circ} \text{ DN added, gal. (or L)}}{\text{total water in wheel, gal. (or L)}} \times 100$$

### Discussion

Add-on is related to solution concentration and wet pickup in the following manner:

$$\% \text{ Add-on} = \frac{\% \text{ solution concentration} \times \% \text{ wet pickup}}{100}$$

When two of these three factors are known, the third can be easily calculated. Generally, the amount of add-on is set at the desired level. Then, with a known wet pickup, the needed solution concentration (i.e., AVITEX® DN) can be calculated. AVITEX® DN is added to the wash wheel to give this concentration and the subsequent calculated add-on.

### Example 1

#### Given:

**Wash Wheel:** Open pocket, 42 in. x 96 in.  
(107 cm x 244 cm), 400 lb (181 kg)  
capacity

**Load:** 300 lb (136 kg) garments of NOMEX® III  
aramid fiber

**Water Level:** 6 in. (15 cm) running, loaded

**Total Water in Wheel:** 160 gal. (606 L)

**Plant Process:** Wash/light extract/tumble dry finish

**Wet Weight Pickup:** 55% (determined after  
extraction; see definitions)

#### Problem:

Using this information, determine:

- (1) The wash wheel solution concentration needed to give a calculated add-on of 0.5% of AVITEX® DN; and
- (2) The amount of AVITEX® DN that must be added to the wash wheel to give this solution concentration.

#### Solution:

$$\% \text{ Add-On} = \frac{\% \text{ solution concentration} \times \% \text{ wet pickup}}{100}$$

$$\frac{1}{\% \text{ solution concentration}} = \frac{\% \text{ wet pickup}}{\% \text{ add-on} \times 100}$$

$$\% \text{ Solution Concentration} = \frac{\% \text{ add-on} \times 100}{\% \text{ wet pickup}} = \frac{0.5 \times 100}{55} = 0.91$$

<sup>1</sup>Based on the dry weight of the goods.

<sup>2</sup>As the goods enter the final drying operation. Wet pickup depends on a number of factors, including whether or not the goods are extracted and, if so, how much? Wet pickup must be determined for each laundry procedure and, like other variables, must be redetermined if the laundry process is altered significantly.

<sup>3</sup>Varies with running water level in wheel. Must be determined by actual measurement, or calculated from the equipment manufacturer's specifications. Include water required to saturate clothes, as well as “free” water typically given in tables.

The wash wheel contains a total of 160 gal. (606 L) of water. The number of gallons (liters) of AVITEX® DN softener that must be added to give a 0.91% concentration can be approximated by using the following formula:

$$\text{AVITEX}^\circ \text{ DN} = \frac{\text{total water} \times \% \text{ solution concentration}}{100} = \frac{160 \text{ gal. (606 L)} \times 0.91}{100} = 1.46 \text{ gal. (5.5 L)}$$

**Example 2**

**Given:**

*Wash Wheel:* Open pocket, 42 in. x 96 in. (107 cm x 244 cm), 400 lb (181 kg) capacity

*Load:* 300 lb (136 kg) garments of NOMEX® III aramid fiber

*Water Level:* 6 in. (15 cm) running, loaded

*Total Water in Wheel:* 160 gal. (606 L)

*Plant Process:* Wash/hang/wet-to-dry tunnel finish

*Wet Weight Pickup:* 95% (determined at entrance to tunnel finisher)

**Problem:**

Using this information, determine:

- (1) The solution concentration needed to give an add-on of 0.5% of AVITEX® DN; and
- (2) The amount of AVITEX® DN that must be added to the wash wheel to give this solution concentration.

**Solution:**

$$\% \text{ Add-On} = \frac{\% \text{ solution concentration} \times \% \text{ wet pickup}}{100}$$

$$\frac{1}{\% \text{ solution concentration}} = \frac{\% \text{ wet pickup}}{\% \text{ add-on} \times 100}$$

$$\% \text{ Solution Concentration} = \frac{\% \text{ add-on} \times 100}{\% \text{ wet pickup}} = \frac{0.5 \times 100}{95} = 0.53$$

The wash wheel contains a total of 160 gal. (606 L) of water. The number of gallons (or liters) of AVITEX® DN needed to give a 0.53% concentration can be approximated by using the following formula:

$$\text{AVITEX}^\circ \text{ DN} = \frac{\text{total water} \times \% \text{ solution concentration}}{100} = \frac{160 \text{ gal. (606 L)} \times 0.53}{100} = 0.85 \text{ gal. (3.2 L)}$$

## APPENDIX V: SOFTENER/ANTI-STAT ADDITIONS CHART

Use the chart below to obtain an add-on of 0.50% of AVITEX® DN softener/anti-stat after determining the percentage of wet pickup of garments and the total number of

gallons (or liters) of water in the wheel. The gallons (or liters) of AVITEX® DN to add to the wheel can be found at the intersection of the appropriate columns.

Wet Pickup, % <sup>**</sup>	Total Water in Wheel, <sup>*</sup> gal. (L)				
	30 (114)	50 (189)	100 (379)	200 (757)	300 (1,136)
30	0.50 (1.9)	0.83 (3.1)	1.50 (5.7)	3.33 (12.6)	5.00 (18.9)
40	0.38 (1.4)	0.62 (2.3)	1.25 (4.7)	2.50 (9.5)	3.80 (14.4)
50	0.30 (1.1)	0.50 (1.9)	1.00 (3.8)	2.00 (7.6)	3.00 (11.4)
60	0.25 (0.9)	0.42 (1.6)	0.83 (3.1)	1.70 (6.4)	2.50 (9.5)
70	0.21 (0.8)	0.36 (1.4)	0.71 (2.7)	1.40 (5.3)	2.10 (8.0)
80	0.18 (0.7)	0.31 (1.2)	0.63 (2.4)	1.25 (4.7)	1.80 (6.8)
90	0.17 (0.6)	0.28 (1.1)	0.56 (2.1)	1.10 (4.2)	1.70 (6.4)
100	0.15 (0.6)	0.25 (0.9)	0.50 (1.9)	1.00 (3.8)	1.50 (5.7)
110	0.14 (0.5)	0.23 (0.9)	0.45 (1.7)	0.90 (3.4)	1.40 (5.3)
120	0.13 (0.5)	0.21 (0.8)	0.42 (1.6)	0.83 (3.2)	1.30 (4.9)
130	0.12 (0.5)	0.19 (0.7)	0.38 (1.4)	0.77 (2.9)	1.20 (4.5)
140	0.11 (0.4)	0.18 (0.7)	0.36 (1.4)	0.71 (2.7)	1.10 (4.2)
150	0.10 (0.4)	0.17 (0.6)	0.33 (1.2)	0.66 (2.5)	1.00 (3.8)

<sup>\*</sup>Tables provided by wash wheel manufacturers typically give only the amount of water (3 gal. or 3.78 L) that must be added to a saturated running load to bring the water level up to a specified height (1 in. or 2.54 cm). Add to this amount the amount of water required to saturate the load, usually estimated to be 0.3 gal./lb (2.5 L/kg) of goods in the wheel.

<sup>\*\*</sup>See Appendix IV.

## APPENDIX VI: EXHAUSTION PROCEDURE FOR ZONYL® 6991 APPLICATION\*

Adding ZONYL® 6991 is the last procedure in the wash cycle. It should be added with agitation at water temperatures at or below 100°F (38°C). This procedure results in an exhaustion of approximately 80% of the active ingredients onto the fabric.

### *Guidelines for Application*

- In the last rinse cycle, use either citric or acetic acid to adjust the pH of the water to between 4.5 and 5.5.
- After adjusting the pH, add ZONYL® 6991 with agitation at a water temperature of 100°F (38°C) or less.
- With continued agitation, raise the water temperature to a minimum of 120°F (49°C) and hold for five to 10 minutes. Higher water temperatures (up to 160°F [71°C]) will aid in the application of ZONYL® 6991.
- After application of ZONYL® 6991, drop the water bath and extract the garments. Do not rinse garments.
- After extraction, dry garments according to care instructions. For garments of NOMEX®, use a maximum stack temperature of 160°F (71°C). Drying is important to ensure proper performance of the ZONYL® 6991.

\*Refer to the ZONYL® 6991 Technical Bulletin

