

# Nomex<sup>®</sup> Aramid fiber

Laundering guide

Never quit™

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# Section I

## Introduction to Nomex® aramid fiber

### General information

Nomex® aramid fiber has been used in garments for 50 years for protection against threats from fire, heat and arc flash. Over time, the line of Nomex® products has expanded and evolved to include blends like Nomex® with Kevlar®, other inherently flame resistant (FR) materials and static-dissipative fibers. The family of Nomex® aramid fibers for thermal protective apparel now includes:

- Nomex® IIIA, a blend of Nomex®, Kevlar® and a static-dissipative fiber
- Nomex® III, a blend of Nomex® and Kevlar®
- Nomex® MHP, an engineered blend of materials offering inherent multi-hazard protection against heat, flame, electric arc and small molten metal splash
- Protera®, a unique blend of inherent materials designed for both electric arc and flash fire protection
- Producer-colored Nomex® fibers, featuring inherent flame resistance with built-in color that can be blended with other materials
- 100% Nomex® T-450, used in its natural, undyed state or dyed for sewing thread
- Nomex® filament with higher strength and chemical resistance compared to staple spun yarn, available in natural white or producer colors

Properly dyed and finished garments made of Nomex® aramid fiber are inherently flame resistant, meaning the flame resistance is a permanent or inseparable attribute of the fibers that cannot be washed out or worn away. No laundry procedures are known that remove the flame resistance of Nomex®. However, thermal protection can be compromised if there are flammable contaminants, stains or soiling on the garment or fabric from which it is made. Even though garments made of Nomex® are inherently flame resistant, flammable contaminants, such as oil or grease, on the clothing can ignite and burn until consumed, thus increasing potential burn injury to the wearer.

Laboratory tests have shown that the procedures recommended in this guide are effective in removing oil-based soils from garments while minimizing the impact on colorfastness and wear life. Users of garments made of Nomex® should ensure that the techniques they use achieve similar results. Please refer to the manufacturer's laundering and care instructions for turnout gear and firefighter protective hoods made with Nomex®.

This guide is intended to provide general recommendations on conditions and products for laundering garments made of Nomex®. Throughout the remainder of this guide, all variations of Nomex® and blends of Nomex® will be referred to as Nomex®. The products, under conditions described in this guide, performed well in laboratory evaluations; other conditions and products may provide equivalent results.

# Section II

## Commercial laundering garments made of Nomex® aramid fiber

### Sorting and washer loading

Garments made of Nomex® should be washed separately from other clothing made of flammable fibers, such as cotton, to avoid contamination. Dark colored clothing made of Nomex® should be sorted and washed separately from very light shades or undyed clothing to avoid possible staining of light colored clothing.

To ensure thorough cleaning, washer loads for garments made of Nomex® should be approximately 2/3 the weight of loads recommended by the washing machine manufacturer.

### Washing supplies

A source list for industrial laundering products is presented in Section VI: Appendix. Other products also may provide acceptable results.

### Detergent

Many commercial and industrial detergent formulations have been evaluated in the laboratory for their cleaning effectiveness and impact on wash-fastness. Tests show that formulations designed for use at a temperature of 140°F (60°C) or less—such as high surfactant, low-alkalinity products—adequately clean Nomex® and provide the best fabric color retention. The use of soaps for laundering Nomex® is not recommended due to the potential formation of insoluble residue with hard water. Soap residue may be flammable and could adversely affect the thermal protective performance of the garment.

### Alkalinity (pH)

Detergents with pH values ranging from 9 to 11 have been found to effectively lift dirt and oil from Nomex® fiber. The use of higher wash temperatures and detergent formulations with higher alkalinity will improve cleaning; however, these harsher conditions can negatively impact the colorfastness of the garments. Users must choose appropriate laundering conditions to maintain the desired balance between garment cleanliness and color retention.

### Bleach

Only oxygen-based bleach is recommended for use on garments made of Nomex®—chlorine bleach should not be used. Although chlorine bleach will not affect the inherent flame resistance of Nomex®, it may cause loss of strength and color in clothing over time.

### Sour

When laundering items made of Nomex®, the use of a sour after thorough rinsing helps ensure that any remaining traces of alkalinity are neutralized. This eliminates the possibility of skin irritation.

### Softeners, anti-stats and wicking agents

Softeners, anti-stats and wicking agents perform useful and often highly desirable functions when applied to the load in the last commercial laundering operation. Flammable materials added when laundering FR garments have the potential to remain on the garment and have a negative effect on the thermal protection of the garment. The impact of fabric softeners, wicking agents and anti-stats should be evaluated at the intended use level prior to routine use.

- Fabric softeners impart a softer hand to the fabric and assists in wrinkle removal when articles made of Nomex® are tunnel or tumble dried.
- Anti-stats reduce the effects of nuisance static electricity, such as clinging and lint pick-up. Nuisance static is fairly common with textiles, especially in low-humidity environments. Under normal conditions, garments made of Nomex® IIIA, Nomex® MHP and Protera® do not require the use of anti-stats because these products already contain a proprietary static-dissipative fiber.

Note: Although certain anti-stats can provide a high degree of static control when properly applied in the washer, they cannot ensure safety in situations where a discharge of static electricity could create a hazard to life or property, such as in an explosive or highly flammable environment. For this reason, it is important that personnel and equipment be properly grounded for maximum safety.

- Wicking agents help fabrics adsorb and spread moisture. Experience suggests that these characteristics contribute to comfort in warm, humid environments by helping to rapidly dissipate perspiration, thereby taking full advantage of the cooling effect of evaporation

## Non-durable water and oil repellents

Water and oil repellency may be a desirable feature in some industrial applications. If the original fabric has not been treated with a repellent, water and oil repellency can be obtained by using sprays or laundry-applied chemicals. Laboratory tests have shown that fluorocarbon sprays, such as FIRELINE WINSOL GUARD 690 PLUS, when applied according to manufacturers' recommendations, will impart water and oil repellency to items made of Nomex® with minimal effect on the thermal protection of the garment. These materials will cause liquids to bead on the fabric surface and minimize wicking into the fabric. They will not, however, prevent liquids from being forced through the open structure of the fabric.

The use of these or other chemicals should be evaluated with respect to the particular oils and/or solvents encountered to determine if they meet the required chemical and thermal protective performance criteria. In addition, because these water repellents may wear away or wash out, retreatment may be necessary, especially after garment cleaning.

## Washing procedures

### General wash formulas

The products in the appendix have been developed to wash garments made of Nomex®. Modifications should be made to meet the needs of particular types of wash loads and other specific quality standards. Product suppliers should be contacted to achieve the most desired result.

### Wash temperatures

Detergents are primarily designed to work at 140°F (60°C). At this temperature, these surfactant-based formulas effectively lift oils and soil while maximizing color retention. For heavily stained and oily garments made of Nomex®, a higher temperature wash formula may be required for adequate cleaning. The use of higher temperature formulas will not affect the inherent flame resistance of the clothing nor overall wear life. However, higher wash temperatures or alkalinity levels may adversely affect garment colorfastness. Where color loss is a concern, dry cleaning is an alternative method to remove heavy soil while minimizing color fading.

### Prevention of soil redeposition

To improve soil removal and minimize soil redeposition in heavily soiled loads, add washing supplies to the suds cycle. Ensure that the concentration is kept high enough to keep the soil in suspension.

### Rinsing

Garments made of Nomex® must be adequately rinsed to remove residual wash chemicals. Rinse cycles should be continued until the pH of the rinse closely approaches that of the water supply. To minimize washer-induced wrinkles, water temperature should be reduced in each succeeding rinse cycle until the last operation (sour), where it should be 90°F (32°C) or lower.

## Souring

Residual alkalinity in garments made of Nomex® can cause skin irritation. To ensure that all traces of wash chemical alkalinity are neutralized, sour can be added to the final rinse cycle in the washer. Garments should not be rinsed additionally after the sour is added. Overuse of sours should be avoided because it will result in highly acidic fabrics. Any standard or buffered sour is acceptable for use with items made of Nomex®. Check the flame resistance properties before use.

## Softeners, anti-stats and wicking agents

Generally, softeners and anti-stats are not permanently affixed to fabrics. Instead, they should be applied in the last washer operation, then reapplied at the end of each subsequent wash cycle. Most softeners and anti-stats are compatible with sours and can be applied in the sour bath. When applying any proprietary laundry product in the washer, it is essential to seek the supplier's advice on its exact use and possible effect on the flammability and thermal protection of the garment.

Although the use of anti-stats may not be required with garments made of Nomex® IIIA, Nomex® MHP or Protera®, the feel and wickability of such clothing can be improved with softeners and wicking agents.

## Repellents

Some fabrics are treated with water repellents during the manufacturing operation prior to the fabrication of clothing. These treatments may last for many cleanings, but they are not considered permanent. Other repellents are available that can be applied during or after laundering to previously untreated garments, or to previously treated garments that have lost their repellency.

Repellent applications will reduce moisture wicking and can make garments that come in contact with the body less comfortable in hot, humid weather. In addition, repellent chemicals may be flammable. Before applying any repellent, it should be evaluated to determine if it will impact the thermal protective performance of the garment.

Repellents can reduce the penetration of oils, solvents and water through the fabric by causing them to bead-up on the fabric surface. The level of repellency depends on the type and level of the material being applied, as well as the characteristics of the soils coming into contact with the garment. Chemical or liquid splash protection for industrial work or laboratories requires a specially treated fabric or an appropriate secondary chemical barrier suit. Protective treatments added by other manufacturers to fabrics made of Nomex® may require special laundering procedures. Please refer to the manufacturer's laundering and care instructions.

## Drying and finishing

### General guidelines

Garments made of Nomex® dry faster than many other FR garments and can be finished with good appearance using several methods. Economic savings are possible if drying and finishing are combined into one step, as with the wet-to-dry tunnel method.

No matter which method is chosen, every effort should be made to avoid introducing hard-set and unnecessary wrinkles during washing or extraction. For best results, garments should not be bagged. However, if bagging is necessary, the bags should not be filled to more than half their capacity to ensure that the items have adequate freedom of movement. Similarly, the washer should not be overloaded. After the break and suds cycles, the water temperature should gradually be reduced through several rinse cycles to avoid introducing "thermal shock" wrinkles, which can be very difficult to remove. The final operation (sour) should be carried out at a temperature of 90°F (32°C) or lower.

Garments should not be fully extracted unless they are to be pressed. If an extraction is used as a preliminary step to other finishing methods, items should be cold and subjected only to very brief and light hydraulic or centrifugal pressure. Extraction will reduce softener add-on by diminishing water carry-over; thus, a higher softener concentration in the final rinse will be required to achieve the desired add-on.

### Tumble dry conditioning/finishing

In some instances, tumble dry conditioning is the only finishing necessary for garments made of Nomex®. Tumble dry conditioning also can be done prior to dry-to-dry tunnel finishing or pressing. Adequate tumbling action is necessary for good wrinkle removal; therefore, tumble dryers should not be overloaded. Clothing will dry rapidly and satisfactorily at exhaust air temperatures between 140°F (60°C) and 160°F (71°C). Garment temperature measured in the basket should not exceed 280°F (138°C). Excessive shrinkage and color loss can occur if higher temperatures are encountered. Tumbling without heat for an additional 10 minutes at the end of the drying cycle will cool the garments and help avoid dryer-induced wrinkles. To avoid set-in wrinkles, garments should not remain in a hot tumbler when it is not in motion, nor should they be folded or stacked.

### Wet-to-dry type tunnel drying/finishing

With this method, wet items from the washer are hung on hangers, placed on a conveyor and passed through a tunnel containing forced air supplied at 300°F (149°C) dry bulb and 190°F (88°C) wet bulb. Garments subjected to this combination of heat and air movement dry and finish wrinkle free and ready to wear. Garment temperature should not exceed 280°F (138°C).

After exiting the tunnel, clothing should hang freely and should not be compressed against other garments until they have cooled to below 100°F (38°C).

### Dry-to-dry type tunnel drying/finishing

After being conditioned in a tumble dryer, garments can be hung on hangers and rapidly and continuously conveyed through an abbreviated finishing cabinet. Steam, heat and forced air agitation minimize wrinkles and allow processing in a short period of time.

### Pressing

If pressing is required, a steam-heated hot head press is recommended with a steam pressure of 80 psig (325°F [163°C]) and a steam/bake/vacuum cycle of 5/10/5 seconds. If an electrically heated hot head is used, a temperature of 375°F (191°C) should be used for 20 seconds as a starting point. Garments should be examined for glazing and dye sublimation before adopting these methods on a commercial basis.

### Laundering study with DuPont and FFT Technologies, LLC.



Garments made of Nomex® shown before and after commercial laundering. Laboratory tests have shown that the laundering procedures recommended in this guide are effective in removing oil-based soils from garments made of Nomex® while minimizing the impact on colorfastness and wear life.

# Section III

## Home laundering garments made of Nomex® aramid fiber

### General guidelines

Items made of Nomex® can be washed and dried by any conventional home method using normal household washers and dryers followed by hand ironing if necessary. No special technology is needed for home laundering garments made of Nomex®. However, for heavily soiled clothing, home laundry 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 made of Nomex®.

If home laundering does not remove contaminants or contaminant build-up, garments should be 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.

Adhering to the following procedures can help provide optimum cleaning.

### Sorting

Items made of Nomex® should be sorted and washed separately from other garments to prevent contamination with lint of flammable fibers such as cotton.

### 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 made of Nomex®, pockets should be emptied, pants cuffs cleaned out and zippers closed.

### Load size

When laundering clothing made of Nomex®, it is important not to overload the machine. To ensure a cleaner wash and avoid setting wash wrinkles, the load size must allow clothes to move freely through the wash water and rinse cycle. Regardless of the machine's rated weight capacity, 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 made of Nomex® require a higher water temperature setting. Using the steam setting on a home washer will not impact the inherent flame resistance of Nomex®; however, prolonged use could cause color fading.

### Detergents

Synthetic, heavy-duty liquid laundry detergents are recommended for washing items made of Nomex®. These detergents 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. Underuse 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 made 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 non-precipitating type of water conditioner should be added. Softening the water improves the quality of washing.

## **Bleaches**

Only oxygen-based bleaches such as OxyClean™ should be used on clothing made of Nomex®. Chlorine bleach should not be used. Although chlorine bleach will not affect the inherent flame resistance of Nomex®, it may cause loss of strength and color in garments over time.

## **Fabric softeners and anti-stats**

Under normal conditions, garments made of Nomex® IIIA, Nomex® MHP and Protera® do not require the use of anti-stats because these products contain a proprietary static-dissipative fiber. Nevertheless, numerous washer- and dryer-applied fabric softeners are available for use in home laundering. These products improve the feel of items made of Nomex® and can reduce the nuisance effects of static electricity—such as lint pick-up and clinging—that are often experienced with fabrics. However, they are not as effective as antistatic treatments applied by an industrial or commercial laundering facility.

NOTE: Antistatic additives cannot ensure safety in situations where a discharge of static electricity could create a potential hazard to life or property. If clothing made 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.

## **Other washing additives**

Commercially available laundry additives or aids, such as scent booster, fabric conditioner, odor eliminator, static guard, wrinkle release or wrinkle remover should not be used with items made of Nomex® if they are flammable. Flammable materials on the surface or within fabric made of Nomex® could adversely affect thermal protection.

## **Drying**

Clothing made of Nomex® will have a smoother appearance when tumble dried instead of being line or drip dried. If line or air drying, flatten garments to minimize wrinkles. Articles made of Nomex® should not be dried in sunlight, which can cause fading but does not affect the flame resistance protection of the garment.

To ensure maximum removal of wrinkles, tumble dryers should not be overloaded. Drying time varies with garment materials and size of the load. Items made 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. The cool down or wrinkle control cycle may be helpful to minimize wrinkles. Use of the steam setting on a home dryer will not impact the inherent flame resistance of Nomex®; however, prolonged use could cause color fading.

## **Other drying additives**

Commercially available laundry additives or aids, such as dryer sheets or static guard, should not be used with items made of Nomex® if they are flammable. Flammable materials on the surface or within fabric made of Nomex® could adversely affect thermal protection.

## **Ironing**

If clothing made of Nomex® needs pressing or ironing, a steam or dry iron may be used at the medium setting. Commercially available ironing aids such as starch, ironing spray or wrinkle spray should not be used with items made of Nomex® if they are flammable. Flammable materials on the surface or within fabric made of Nomex® could adversely affect thermal protection.



# Section IV

## Dry cleaning garments made of Nomex® aramid fiber

### **General guidelines**

Clothing made of Nomex® can be dry cleaned successfully in any conventional commercial dry-cleaning system. With heavily soiled garments, using a two-bath cycle may improve soil removal and minimize redeposition. Items made of Nomex® should be cleaned separately from items made of other materials to avoid contamination with lint from flammable fibers such as cotton. The practice of maintaining a clean solvent supply must be observed.

# Section V

## Removing spots and other non-standard contaminants from garments made of Nomex® aramid fiber

### General guidelines

Properly dyed and finished clothing made of Nomex® is inherently 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. When accidental exposure occurs, the contaminant should be removed as soon as possible before it sets in or dries. The contaminated garment should be clearly identified so the cleaning facility can spot clean the garment before routine laundering or dry cleaning.

For work assignments where employees are routinely exposed to paint, epoxy or other contaminants that are difficult or impossible to remove, the use of flame-retardant disposable coveralls as over-garments should be considered. Only secondary FR disposable coveralls, such as some DuPont™ Tychem® products, should be worn over primary FR personal protective equipment (PPE). Wearing disposable secondary FR coveralls over clothing made of Nomex® will maintain the wearer's FR protection, minimize laundering issues and prolong the life of the garment made of Nomex®.

Nomex® fiber is resistant to most chemicals typically used to launder, dry clean or spot clean clothing, 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 made 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, items should be thoroughly rinsed to ensure the removal of any residual flammable solvents.

# Section VI

## Appendix

### Source list for commercial laundering products

Product / Trademark	Detergent / Sour vendor
E-Max Detergent Performance Industrial Detergent Performance Industrial Booster Performance Industrial XXEL Detergent Performance Industrial XXL Sour Turbolizer	<b>Ecolab, Textile Care Division</b> 1 Ecolab Place St. Paul, MN 55102 (800) 553-8683 www.ecolab.com
FFT Laundry Cleaner	<b>FFT Technologies, LLC</b> (formerly Fog Free Technologies) 4365 Dorchester Road, Suite 301 North Charleston, SC 29405 (843) 735-6626 www.fftlaundry.com
BIO-POWER DESTAINEX ENDOW	<b>U.N.X. Incorporated</b> 707 E Arlington Blvd Greenville, NC 27858 (252) 756-8616 www.unxinc.com
Spectrum Structure Secure	<b>Washing Systems, LLC (WSI)</b> 167 Commerce Drive Loveland, OH 45140 (800) 272-1974 www.washingsystems.com
Product / Trademark	Antifoams vendor
Xiameter® AFE-1430 Dow Corning® Antifoam 1430	<b>Dow Corning</b> PO Box 994 Midland, MI 48686 (800) 248-2481 www.xiameter.com
Product / Trademark	Anti-static vendor
U.N.X. ANTI-STAT	<b>U.N.X. Incorporated</b> 707 E Arlington Blvd Greenville, NC 27858 (252) 756-8616 www.unxinc.com

## Source list for commercial laundering products

Product / Trademark	Water/oil repellents vendor
FIRELINE WINSOL GUARD 690 PLUS	<b>WINSOL Laboratories</b> 1417 NW 51st Street Seattle, WA 98107 (800) 782-5501 www.winsol.com
Product / Trademark	Disinfectant vendor
I D O Cleaner, Disinfectant and Sanitizer	<b>WINSOL Laboratories</b> 1417 NW 51st Street Seattle, WA 98107 (800) 782-5501 www.winsol.com

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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 made 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.

**For more information about Nomex® or for global product support, contact us in your region:**

### **USA**

DuPont  
5401 Jefferson Davis Highway  
Richmond, VA 23234  
Tel: 800-931-3456  
Corporate.Inside-Sales@  
DuPont.com

### **Japan and Asia Pacific**

DuPont K.K.  
Sanno Park Tower  
11-1, Nagata-cho 2-chome,  
Chiyoda-ku, Tokyo 100-6111  
Tel. 81-3-5521-8688

### **Canada**

E.I. DuPont Canada Company  
P.O. Box 2200  
Streetsville Postal Station  
Mississauga, Ontario, L5M 2H3  
Canada  
Tel: 800-387-2122  
information@can.DuPont.com

### **South America**

DuPont do Brasil S. A.  
Alameda Itapecuru, 506  
Alphaville - Barueri  
Sao Paulo, Brasil  
06454-080  
Tel: +0800-17-17-15  
+55 11 4166 8295

### **Europe**

DuPont de Nemours  
International S. A.  
P.O. Box 50  
CH-1218 le Grand Saconnex  
Geneva, Switzerland  
Tel: +41-22-717-5111

Product safety information is available upon request.

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