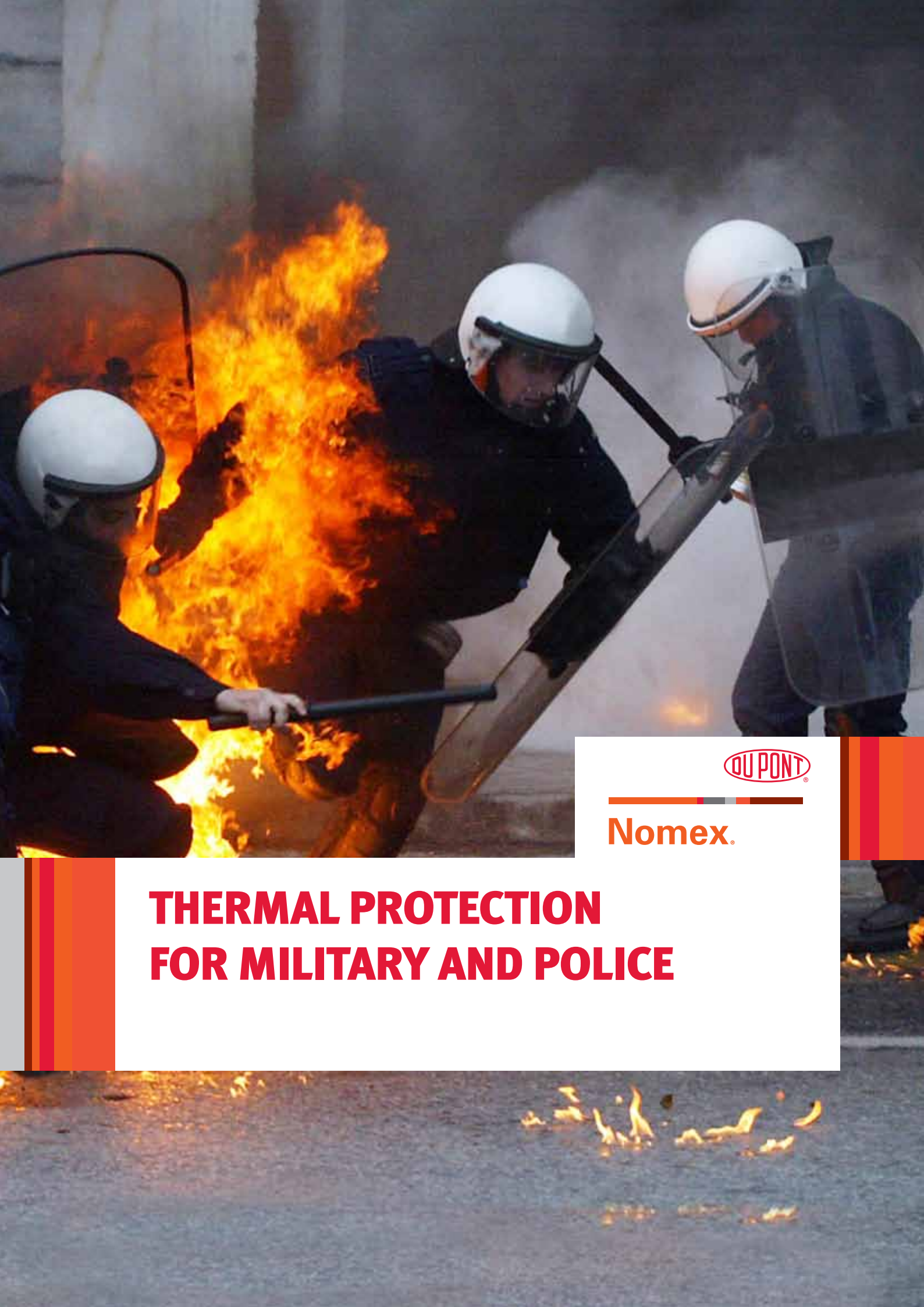


DUPONT®

Nomex®

THERMAL PROTECTION FOR MILITARY AND POLICE

DuPont™ Nomex® is an inherently flame-resistant, high-temperature resistant meta-aramid fibre that doesn't melt and drip or support combustion in the air.

DuPont™ Nomex® was invented by DuPont in 1967. During the past 45 years, DuPont has continuously enhanced the Nomex® fibres to meet the ever increasing demand for superior protection.







PROTECTING OUR PROTECTORS



DuPont™ Nomex® applications

DuPont™ Nomex® fibres are used across a broad range of applications. It is a critical component in the protective apparel and accessories used by police officers, first responders, civil rescue teams, civilian, police and military pilots, sailors and ground forces all over the world. Nomex® protects these wearers from flames and the intense heat they may encounter. It offers superior thermal insulation, durability and freedom of movement.

DuPont™ Nomex® is also used in apparel worn by firefighters. In motor racing, Nomex® brand fibres are the most commonly used materials for apparel protecting the majority of drivers, pit crew members and track officials against the danger of flash fire at the race track.

Nomex® is used in personal protective clothing for a wide variety of industrial end uses. From offshore drilling platforms, petrochemical, chemical and pharmaceutical industries to electrical utilities, electricians and foundries.

Nomex® garments have proven to be a reliable and trusted solution, whether the hazards are flash fire, fire, explosion, electrical arc, molten metal splashes, static discharge, chemical or where visibility is low.

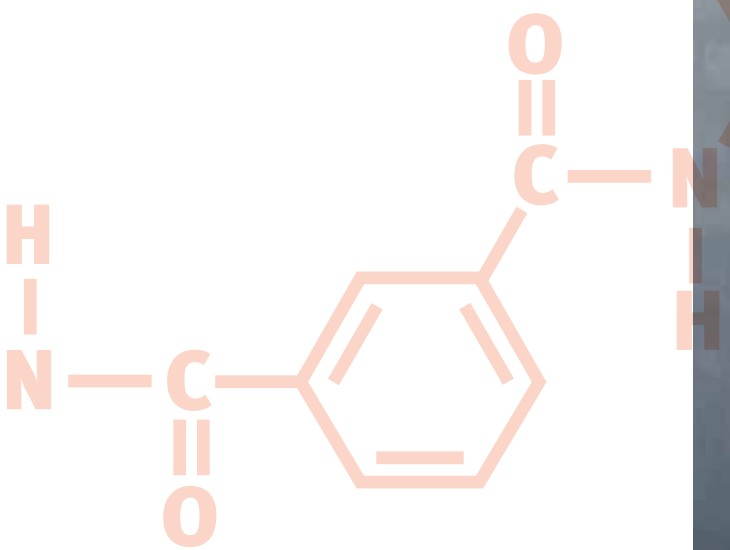


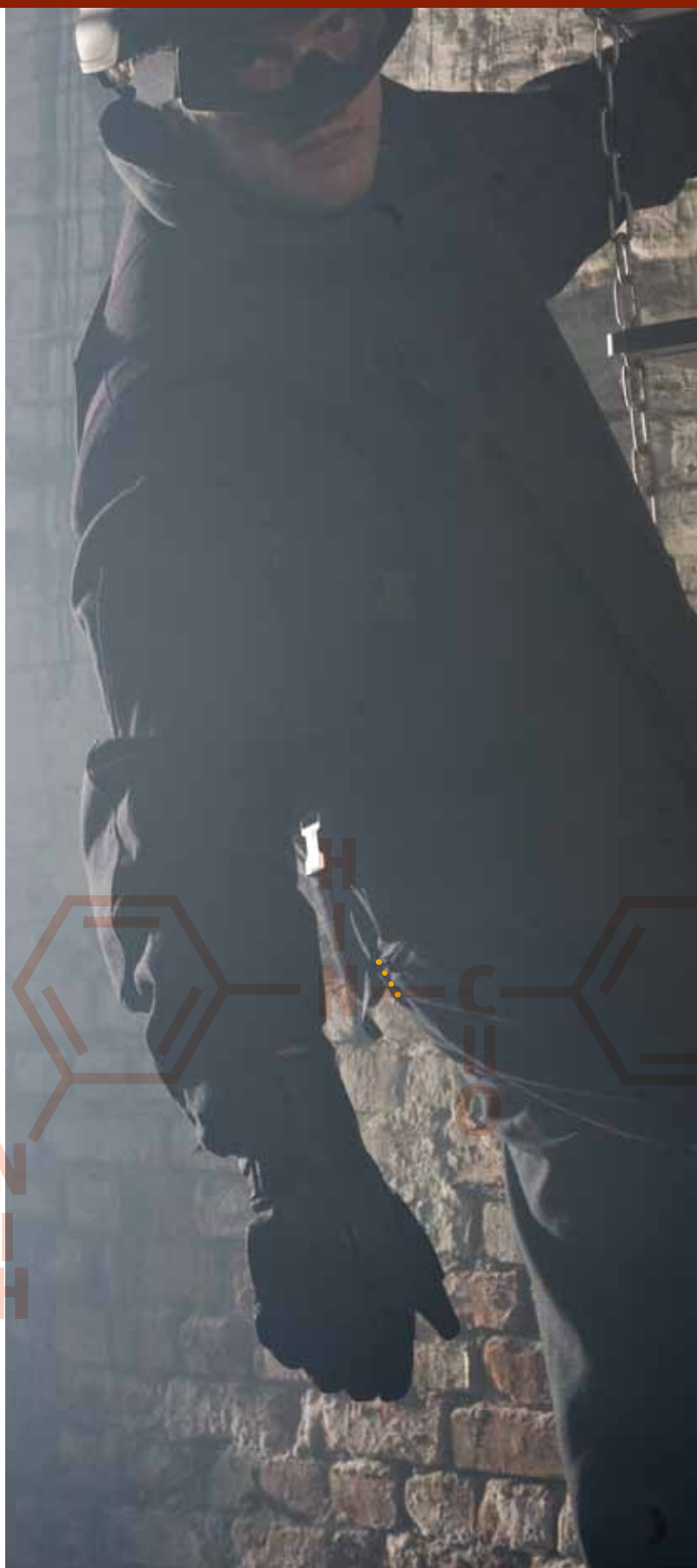
WHY DUPONT™ NOMEX®?

A key factor in the protection provided by Nomex® is its ability to carbonize and thicken when exposed to intense heat. This typical reaction increases the protective barrier between the heat source and the wearer's skin and minimizes burn injury, almost comparable to the way a car protects its occupants with airbags.

DuPont™ Nomex® derives its flame resistant properties from its **structure** of aromatic rings and conjugated amide bonds. This thermal behaviour is achieved by its molecular structure and not by the application of a flame retardant chemical substance to the fabric, yarn, fibre or polymer.

Nomex® gives long term protection, which cannot be washed out or worn away. The absence of any flame retardant chemical substance substantially reduces the amount of smoke and chemical gasses created in a fire.









Continuous innovation

During the past 45 years, DuPont has continuously **enhanced** the Nomex® fibres.

- Most DuPont™ Nomex® Personal Protective Equipment (PPE) solutions are blended with the para-aramid fibre **DuPont™ Kevlar®**, also developed by DuPont, resulting in a fibre which provides **additional strength** and **structural integrity** when exposed to heat and flame. Pure meta-aramid short staple spun yarn solutions are not recommended for use in PPE applications, as they can potentially break open.

- DuPont added electrostatic charge dissipative fibres to most Nomex® PPE offerings for assured protection against electrostatic discharge hazards.



CHOOSING THE RIGHT THERMAL PROTECTION

Six Selection Criteria

DuPont recommends the use of the following six selection criteria when choosing the most appropriate material for Personal Protective Equipment:

1. **NORMS AND REGULATIONS**
2. **MORE PROTECTION**
3. **WEARER COMFORT**
4. **QUALITY ASSURANCE**
5. **COST EFFECTIVENESS**
6. **PEACE OF MIND**







Common terms in Thermal Personal Protective Equipment

The DuPont Protection Technologies division together with its Nomex® Partners develop and produce fibres and fabric systems that are used in apparel worn by police officers and military personnel fulfilling their duties in challenging environments and requiring protection from heat and flame or dangerous substances.

■ **Flame resistant fabric** is a term used to describe a material that is self extinguishing after removal of an external ignition source. Material can be flame resistant because of the inherent properties of the fibre, or the presence of flame retardants. Also different yarn properties and fabric construction may contribute to increase flame resistance.

■ **Inherently flame resistant** fabrics are fabrics manufactured with fibres such as Nomex® whose innate properties make them naturally flame resistant without a chemical treatment.

■ **Flame retardant treated fabrics** are produced by applying a finish to a fibre or the fabric to reduce its flammability, or by incorporating a flame retardant chemical into the fibre prior to spinning. The flame retardant treatment chemicals are 'activated' by intense heat, producing char and gasses that inhibit combustion for a certain time. The gasses (smoke) produced contribute to reduced visibility and the potential for skin, eye and lung irritation in enclosed environments.

■ **Conventional fabrics** not treated with flame retardant chemicals do not provide adequate protection against thermal hazards. These types of fabrics can ignite, melt or continue to burn on the body, increasing the extent of a worker's burn injury.

■ **High absorbing fibres** is a term used for fibres such as cotton, viscose, modal, lyocell which have a high capacity to absorb liquid. These fibres have the potential to absorb flammable liquids (like petrol bombs) during a riot or fuelling situations, possibly leading to increased burn time on the fabrics. These fibres also show a tendency to absorb liquids such as blood and other contaminants, therefore washing guidelines should be checked to ensure safe cleaning is possible.

■ It is very important that police and military personnel wear **adequate thermal protective flame resistant clothing**. It enables them to perform their job, even under extreme conditions. This will reduce the potential of burn injury and it increases the survival chances of the individual.



DuPont™ Nomex® Comfort

DuPont™ Nomex® fabrics and knits with a hydrophilic treatment (wetting index: i_B: < 1.0) absorb body perspiration quickly and transport the sweat through the fabric away from the skin keeping the wearers' skin dry.
Nomex® fibre absorbs much less moisture than cellulosic fibres like cotton and viscose, therefore garments made of Nomex® dry much more quickly after energetic action, making the wearer feel more comfortable. Knitted fabrics made of Nomex® are available with antibacterial properties.

Fibre composition

93%	1.4 dtex DuPont™ Nomex® meta-aramid
5%	DuPont™ Kevlar® para-aramid
2%	antistatic fibre

Applications

Woven fabrics widely used for police riot suits, NBC protective garments, pilot suits, available in many knitted garment solutions for e.g. underwear (from very light weight 100 g/m² up to 300 g/m²), polo-shirts and fleece jackets (from 240 g/m² up to 400 g/m²) with excellent RTI values, e.g. 300 g/m² with 150 *10-3 m²*K/W. Provides a softer handle to the finished fabric because of the finer dtex.





Antistatic properties

Has antistatic properties - fabric is tested in accordance with EN 1149-3 and fulfils the electrostatic protection requirements of EN 1149-5 for protective clothing.

Protection and norms

Thermal protection against heat and flame (EN531, ISO/FDIS 11612, EN 469) and electrical arc (IEC 61482-2/CDV).

More protection

Protects against low volume chemical splash and mist (EN 13034) if treated with fluorocarbon finish. Additional properties can be achieved by combining fabrics made of DuPont™ Nomex® fibres with other materials to provide protection against environmental hazards of rain (EN 343 and EN 14360), cold and cool environment (EN 342 and EN 14058) and against low voltage electrical current hazard (EN 50286).

Colour availability

Can be supplied pigmented (N307) for best light fastness or piece-dyed (E502).

* Colour availability and lead times need to be confirmed by the converter (spinner, weaver, knitter or garment manufacturer). Individual colour needs should be discussed with a DuPont DPT representative.



DuPont™ Nomex® IIIA

Fibre composition

93%	1.7 dtex DuPont™ Nomex® meta-aramid
5%	DuPont™ Kevlar® para-aramid
2%	antistatic fibre

Applications

Mainly used for blended solutions containing viscose FR and/or other fibre chemistries, resulting in a balanced composite blend meeting the rigors of the application. Woven or knitted fabrics made for single or multi-layer garments, including underwear and shirts.

Antistatic properties

DuPont Nomex® IIIA has antistatic properties. Fabrics made of Nomex® are tested in accordance with EN 1149-3 and fulfil the electrostatic protection requirements of EN 1149-5 for protective clothing.

Protection and norms

Thermal protection against heat and flame (EN531, ISO/FDIS 11612, EN 469) and electrical arc (IEC 61482-2/CDV).





More protection

Nomex® IIIA protects against low volume chemical splash and mist (EN 13034) if treated with fluorocarbon finish. Additional properties can be achieved by combining fabrics made of DuPont™ Nomex® fibres with other materials to provide protection against environmental hazards of rain (EN 343 and EN 14360), cold and cool environment (EN 342 and EN 14058) and against low voltage electrical current hazard (EN 50286).

Colour availability

Can be supplied pigmented (N302) for best light fastness or piece-dyed (T462).



DuPont™ Nomex® ProVis



Fibre composition

43% DuPont™ Nomex®
34% Polyester FR
23% Viscose FR

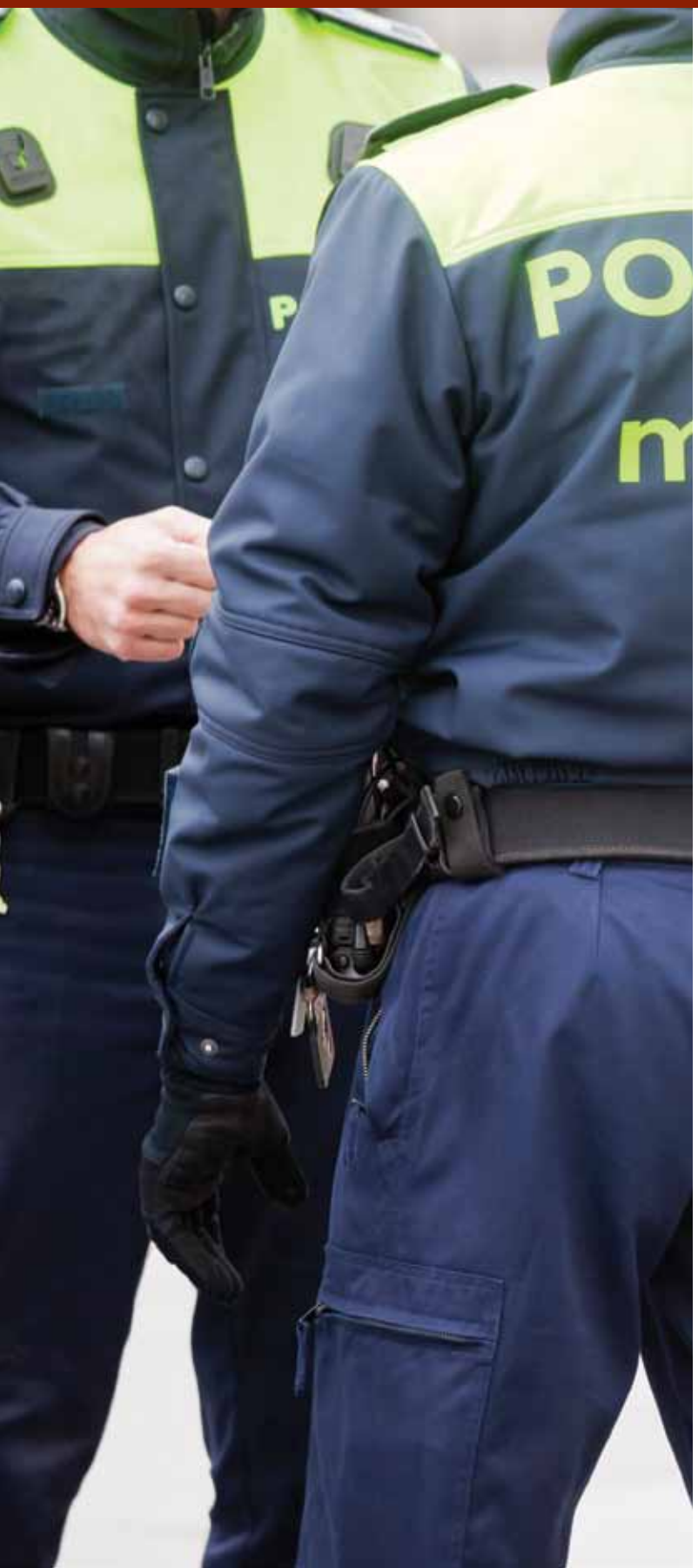
Applications

DuPont™ Nomex® ProVis is a DuPont proprietary solution that fulfils the requirements of EN 471 for high visibility and provides thermal and physical properties similar to Nomex® fabrics.
Nomex® ProVis can be used for police garments and vest covers where visibility is critical, e.g. for operations where road traffic presents a hazard.

Protection and norms

Norms	Nomex® ProVis
EN 471 High Visibility	Yellow
EN ISO 11612 Heat & Flame	A1 (Limited Flame Spread) B1 (Convective Heat) C1 (Radiant Heat) E1 (Molten Iron Splash) F1 (Contact Heat)
IEC 61482-2 Electric Arc	ATPV > 8 cal/cm^2 Class 1
EN ISO 11611 Small Molten Metal Splashes	Class 1
EN 1149-5 Antistatic Properties	Pass
Fabric Weight	270 g/m^2

* For detailed Nomex® ProVis fabric specifications please contact your fabric supplier.



Antistatic properties

DuPont™ Nomex® ProVis has antistatic properties - fabric is tested in accordance with EN 1149-3 and fulfils the electrostatic protection requirements of EN 1149-5 for protective clothing.

Colour availability

The trusted protection of Nomex® available in a high visibility yellow solution.



DuPont™ Nomex® LS

DuPont™ Nomex® LS is a technology platform offering new properties such as light weight and strength to the inherent flame retardant properties of Nomex® fibres.
In addition, LS technology is appropriate for blends with wool.

Fibre composition

93%	1.7 dtex DuPont™ Nomex® meta-aramid
5%	DuPont™ Kevlar® para-aramid
2%	antistatic fibre

Applications

N324 and N329 are yarns made from the Nomex® LS platform which provide superior aesthetics and mechanical properties to the fabrics made thereof.
Mainly used for applications where light weight solutions are required like pilot suits; chemical, biological, radiological and nuclear protection outer fabrics; ballistic vest covers; Explosive Ordnance Disposal suits and police uniforms.

Antistatic properties

Nomex® LS has antistatic properties - fabric is tested in accordance with EN 1149-3 and fulfils the electrostatic protection requirements of EN 1149-5 for protective clothing.





Protection and norms

Thermal protection against heat and flame (EN531, ISO/FDIS 11612, EN 469) and electrical arc (IEC 61482-2/CDV).

More protection

Protects against low volume chemical splash and mist (EN 13034) if treated with fluorocarbon finish. Additional properties can be achieved by combining fabrics made of Nomex® fibres with other materials to provide protection against environmental hazards of rain (EN 343 and EN 14360), cold and cool environment (EN 342 and EN 14058) and against low voltage electrical current hazard (EN 50286).

Colour availability

Mainly supplied piece-dyed.



DuPont™ Nomex® MTP



DuPont Nomex® MTP fabric (Multi-Threat Protection) is a **new** DuPont proprietary solution that fulfils the tough requirements for infantry clothing. It can be printed in most DPM (Disruptive Pattern Material) patterns including demanding IR specifications and provides thermal and physical properties similar to Nomex® fabrics.

Fibre composition

35%	DuPont™ Nomex®
2%	DuPont™ Kevlar®
42%	FR Viscose
10%	Polyamide
10%	Polyester
1%	antistatic fibre

Applications

Nomex® MTP is mainly used for combat uniforms where heat and flame protection is an additional need. Nomex® MTP offers outstanding abrasion resistance and mechanical properties.

Antistatic properties

Has antistatic properties - fabric is tested in accordance with EN 1149-3 and fulfils the electrostatic protection requirements of EN 1149-5 for protective clothing.



Multi-Threat Protection

Protection and norms

Thermal protection against heat and flame (EN531, ISO/FDIS 11612).

More protection

Nomex® MTP (Multi-Threat Protection) can be printed in most army camouflage patterns. It has excellent colour fastness and will meet specified IR requirements.
Nomex® MTP can be treated with vector protection to protect against mosquitos and other insects.
Nomex® MTP offers some protection against small low kinetic energy fragments like residual fragments caused by an explosive device.

Colour availability

Mainly supplied piece-dyed.

* For information on availability please contact your DuPont DPT representative.



European Hazards and Standards for Body Thermal Protective Clothing

	Thermal Hazards	Electrostatic Discharge Hazards	Chemical Hazards
	Heat & Flame	Antistatic properties	Low volume Splash & Mist
	EN 531* prEN ISO 11612*	EN 1149-1** EN 1149-3** EN 1149-5*	EN 13034*
			
Nomex® Comfort			1
Nomex® IIIA			1
Nomex® LS			1
Nomex® MTP			1
Nomex® ProVis			1

Most suitable Suitable

Environmental Hazards	Hazards related to Visiblility
Rain EN 343* EN 14360**	High Visibility DPM camouflage EN 471*
Cold & Cool Environment EN 342* EN 14058**	
2	
2	
2	
2	3 / DPM printing
2	Yellow High-Vis

All PPE are subject to the European Norm EN 340 specifying general requirements for protective clothing. It is the user's responsibility to carry out risk analysis and select the appropriate personal protective equipment.

1. With fluorocarbon finish
2. Properties can be achieved by combining fabrics made of Nomex® fibres with other materials to provide protection against environmental hazards of rain (EN 343 and EN 14360) cold & cool environment (EN 342 and EN 14058) and against low voltage electrical current hazards (EN 50286).
3. Nomex® MTP can be printed to most military specifications including IR reflection requirements.

DPM: Disruptive Pattern Material
*Standards: performance requirements
**Standards: test methods

PEACE OF MIND



DuPont™ Nomex® is developed and produced by DuPont, a recognized leader in safety and protection

DuPont has a corporate commitment to safety with a proven track record of almost 100 years of industrial safety management and holds a safety record above the industrial average (0.3 vs. 50 injuries per 1000 employees).

DuPont has worldwide safety expertise and has over 40 years of experience in the protective apparel market. It has excellent contacts with industry experts and norm committees (ISO, CEN, ASTM, IEC) and maintains an extensive technical database.





Nomex®, engineered to protect:

Nomex® solutions combine:

- the excellent thermal and textile properties of Nomex® meta-aramid fibre
- the high tenacity of the DuPont™ Kevlar® para-aramid fibre
- antistatic fibre

Fabrics made of DuPont™ Nomex® fibres offer inherent and durable heat resistance

- They do not continue to burn when the flame is removed and they do not melt.
- They do not break open when exposed to heat.
- Fabrics made of Nomex® fibres only carbonize at temperatures above approximately 427 °C.
- They do not generate toxic or irritating fumes when exposed to heat and flame.
- They are resistant to a wide range of chemicals.
- They are abrasion, tear and wear resistant for long wear-life.
- They are comfortable, due to the transportation of moisture along the fibre by capillarity action.



MORE PROTECTION

Police and military forces may be exposed to various threats during the course of their duties. Adequate protection is needed against:

- bullets and shrapnel (ballistic protection - Kevlar®)
- CBRN threats
- cold and wet weather (laminated Nomex® solutions)
- blunt trauma and stab (Kevlar® AS Multi Threat Protection solutions)
- heat and flame (Molotov Cocktails, explosive environments, exploding munitions) (Nomex® solutions)
- EOD Explosive Ordnance Disposal (combined Nomex® and Kevlar® solutions)

The condition and quantity of heat, flame or fire that military, police and civil emergency personnel can be exposed to is expressed (amongst others) in terms of:

- estimated incident energy, measured in cal/cm^2 or $kW*s/m^2$
- heat flux, or the rate of heat flow across a unit area measured in $cal/cm^2/sec$ or $kW/m^2/sec$





DuPont European Technical Centre

In Meyrin, near Geneva, Switzerland, DuPont has set up its European Technical Centre (ETC). This is an innovating testing facility, where a number of standardized tests are performed. DuPont also developed specific tests which are performed at the ETC and which measure the protective performance against specific simulated thermal hazards (e.g. DuPont™ THERMO-MAN® , DuPont™ ARC-MAN® , DuPont™ Molten Metal Man, steam heat transfer of protective fabrics and garments) and also ballistic testing and stab testing.



MORE PROTECTION

DuPont™ Nomex® Protects against Heat and Flame

Thermal protective clothing is subject to norms EN 531 and EN ISO 11612. DuPont developed two relevant additional test methods which measure the thermal protection level of a fabric or garment.

DuPont Thermal Protection Performance Test (known as 'TPP') subject to NFPA 1971 (2007 edition)

The first test is a fabric test, in which a fabric sample is subjected to circumstances typically found in fires i.e. a constant combination of 50% radiant heat and 50% convective heat, at a constant heat flux.

The test then measures the time elapsed and the amount of heat energy (**TPP value**) needed before the temperature at the back of the fabric reaches a level which would cause a 2nd degree burn to the PPE wearer.
By dividing the TPP value (cal/cm²) by the fabric basis weight (in g/m²), the **Fabric Failure Factor** or **FFF** value is obtained, indicating the thermal insulation performance of the fabric.

A high FFF factor represents a better thermal protection performance per kilo fabric. It thus allows for **an objective comparison of materials** on an equal basis, taking into account the protection/weight ratio. This test cannot predict the thermal





performance of a garment, as other factors such as design of the garment and accessories are important.

DuPont™ Thermo-Man®

The second test developed by DuPont is a garment test. Thermo-Man® is a life-size mannequin equipped with 122 heat sensors. The mannequin is dressed in test garments and then totally engulfed in flames generated by propane gas burners.

This test exposes the garment surface to a flash fire with temperatures rising to 1000°C, simulating a typical industrial heat and flame incident. This fuel fire simulator validates the garment's protective performance and integrity against heat and flame.

The thermo-sensors record the temperature rise on the surface of the mannequin whilst a computer simulation programme calculates:

- the predicted percentage of 2nd and 3rd degree burns a person may suffer under similar conditions
- the position of the burns and the comparative percentage of burns over the total body mass
- the burn evolution over the measured time, calculating the individuals chances of surviving the incident (in %) in conjunction with the victim's age.

Test results, Thermal Protection Performance Test

In this test, Nomex® fabrics were compared with cotton and several cotton blend fabrics treated with flame retardant chemicals.

- Nomex® fabrics better shield the wearer from the onset of body burns.
- Nomex® fabrics provided up to a 35% higher TPP factor or 35% additional time before the wearer would suffer 2nd degree burns.
- Nomex® fabrics retain their protective performance even after 200 washes.
- On a kilo by kilo basis, Nomex® fabrics provide up to twice the thermal efficiency or FFF factor value compared to chemically treated cotton and cotton blend fabrics.
- Personal Protection Equipment made of Nomex® fabrics allows for comfortable lower weight solutions while maintaining excellent protection against heat and flame.



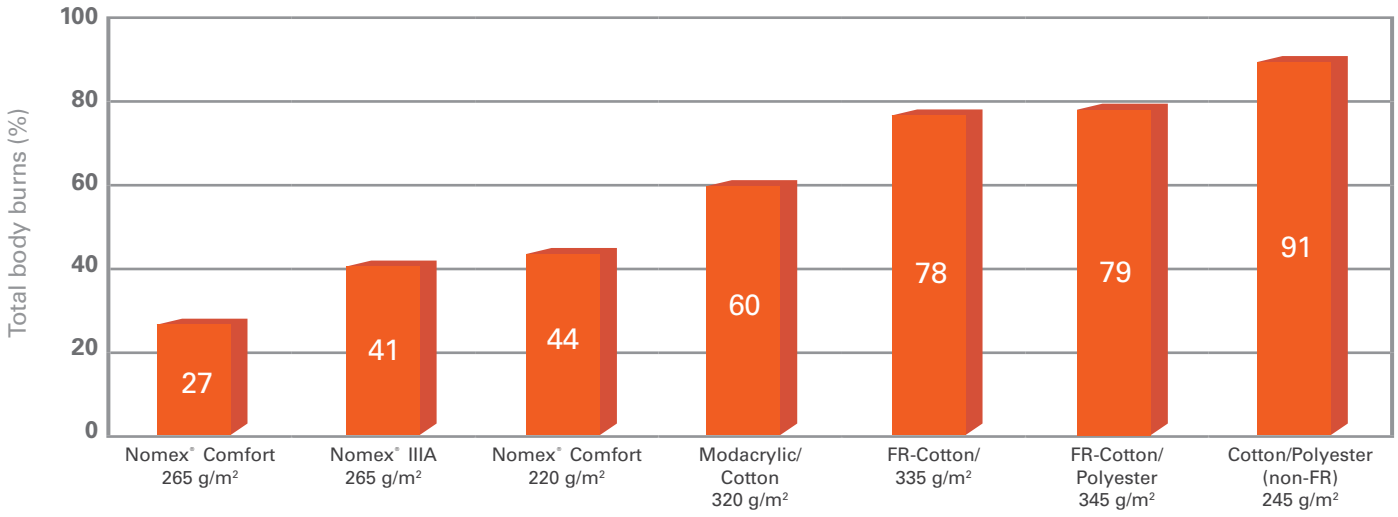
MORE PROTECTION

Test results, Thermo-Man® Test

(relates to ISO 13506)

Standard coveralls (same style and size) of several fabric types and fabric weights (worn together with standard short sleeve cotton underwear), are exposed to heat energy levels of 2 cal/cm²/sec (a reasonable 'mean value' in petrochemical fire incidents), for a duration of 4 seconds. Nomex® garments were compared to cotton and cotton blend garments which had been treated with flame retardant chemicals.
Wearing protective clothing made of Nomex® fabrics results in the lowest percentage of total body burns, increasing the survival chances of a heat and flame victim considerably.

Comparison of Thermo-Man® body burns for workwear made of commonly used fibres







Additional thermal protection against heat of an electrical arc - norms and testing methods for fabrics and garments

(PPE subject to norm IEC 61482-2/CDV)

An electrical arc is a **continuous electric discharge of high current** between two electrodes, generating very bright light and intensive heat. The arc blast presents a **very serious hazard** (potentially fatal) due to the risk of burn injuries caused by intensive heat and by molten metal splashes.
The electric arc also generates hazardous noise and pressure and could also cause injury to the respiratory system.

The **heat energy** that an electrical arc can produce is determined by the level of the arc current, the duration of the arc, the distance between the worker and the arc and the type of arc (open arc or confined arc, e.g. 'arc in a box').

In order to select adequate protective clothing, the potential incident heat energy (in units of energy per square surface) caused by an electric arc, to which a worker may be exposed, needs to be calculated in a thorough risk assessment.
The international standard IEC 61482-2/CDV and, for example, the US NFPA 70E guidelines categorize electrical arc hazards and set up guidelines for protective clothing performance requirements.



MORE PROTECTION



DuPont™ Nomex® LS, Comfort and IIIA protect against additional hazards

DuPont™ Nomex® LS, Comfort and IIIA protect against chemical splash hazards

For this hazard, a PPE is typically subject to norm EN 13034.

Chemical hazards can occur in conjunction with thermal hazards, including chemical splash on to protective clothing, or through chemical leakages.

DuPont™ Nomex® LS, Comfort and IIIA fabrics successfully pass '**Elbow Lean Tests**', in which the fabric is exposed to concentrated acid for 15 minutes, whereas cotton or cotton blends with flame retardant chemical treatment were destroyed. The test also showed that Nomex® fibres are **inherently resistant to many chemicals** in addition to their flame resistant properties.

Nomex® fabrics can offer additional protection against chemical hazards (fulfilling EN 13034, type 6 accidental splashes) if the fabric is treated with an appropriate **fluorocarbon finish**. However, a fluorocarbon finish may need to be regularly re-applied to maintain performance (depending on which fluorocarbon product is chosen – some need re-appliance after a couple of washes, better products can maintain their properties after 40 washes). Fluorocarbon treated

fabrics also offer some protection against rain. The rain is not absorbed by the fabric but droplets simply roll off. Comfort may be compromised if the fabric is in direct contact with the skin as fluorocarbon treated (hydrophobic) fabrics do not absorb perspiration.

DuPont™ Nomex® protects against static electric discharge hazard

A PPE protecting against this is subject to norm EN 1149-5.

Electrostatic discharge (ESD) can lead to the generation of sparks with energy levels sufficient to ignite and create an explosion in potential surrounding vapours, aerosols, flammable liquids or dust particles. **DuPont has developed Nomex® fibre blends using an antistatic fibre**. This antistatic carbon fibre helps fabrics made of Nomex® quickly dissipate static electricity that may have built up on the fabric through contact with another non-conductive surface.

Antistatic fibre is included in the following Nomex® solutions:

- Nomex® Comfort and Nomex® IIIA
- Nomex® MTP
- Nomex® ProVis
- Nomex® LS

Garments made of these materials are tested in accordance with EN 1149-3 and fulfil the electrostatic protection requirements of EN 1149-5 for protective clothing.

Specially treated Nomex® protects against insect bites

This is widely used to protect police officers and military personnel against insect bites. State of the art protection is achieved by applying insecticides to the fabric or garments.





WEARER COMFORT

Selecting protective clothing based on garment weight, antistatic properties and moisture management

There are factors other than safety that determine the effectiveness and wearability of protective apparel: namely comfort and appearance.

DuPont offers design assistance aimed at **translating ergonomic needs into wearer benefits**, so that protective garments can be as **attractive** and **comfortable** as street wear whilst still meeting stringent protection standards.

Comfort is not a luxury, but allows for **more efficient working** and safer decision making.





There are three basic characteristics which have an impact on a wearer's comfort, and which can be measured objectively:

Garment weight

Typical protective fabrics made of DuPont™ Nomex® fibres are between 150-265 g/m² or up to 40% lighter than cotton and cotton blend fabrics which were treated with flame retardant chemicals. Nomex® solutions provide better protection against heat and flame at a lower basis weight.

Antistatic properties

The antistatic properties of a garment or fabric help protect the wearer from the electrostatic discharge hazard but as an additional effect, they also help prevent nuisance static thereby making the wearer feel more comfortable.

Moisture management

A criterion of moisture management is the evaporation of moisture or perspiration from the skin through the fabric structure. The Sweating Guarded Hotplate test method (ISO 11092) measures the resistance of a material to let water vapour through which is expressed as Ret (water vapour resistance in m²*Pa/W).

A fabric's moisture management performance is also influenced by its air permeability, the capacity to let air pass through (tested according to ISO 9237). Air permeability (expressed in litre/m²/sec) is an important measure of comfort, it is a measurement of the air moving through a fabric and around the skin, leaving the wearers skin feeling dry and comfortable.

This is very much improved by hydrophilic treatment of the fabric. Such treatment absorbs the perspiration of the wearer quickly and transports it away through the fabric, keeping the wearer's skin dry, even after exertion in hot conditions (example from non FR is the new modern soccer garments: underwear + T-Shirt). Hydrophilic treatments are recommended for fabrics with garment layers in direct contact with the skin, such as underwear, etc. This treatment is permanent and does not need to be reactivated at a later stage in contrast to hydrophobic treatments. DuPont™ Nomex® fabrics with hydrophilic treatment transport the moisture away from the skin without accumulating it in the fibre as is the case with fabrics made of cellulosic fibres (e.g. cotton or viscose). This leads to much shorter re-drying of the garments, better for the health of the wearer.

For underwear and garments worn directly on the skin, an anti-odour treatment is recommended and available especially for Nomex® knits and fabrics.



WEARER COMFORT

Test results

Typical DuPont™ Nomex® single layer fabrics have **better moisture management** properties than cotton or cotton blended fabrics which have been treated with flame retardant chemicals. The unique dog-bone fibre shape allows for good moisture transportation along the fibre by capillary action. This dog-bone effect is improved by a hydrophilic treatment of the fabric.

Typical Nomex® single layer fabrics **maintain their high air permeability**, even after 200 washes. Cotton based fabrics lose up to 35% of their air permeability after 50 washes, most likely due to fabric shrinkage, as fabrics get denser through washing.

Fabric and garment construction, types of weave or finishing treatments can positively or negatively impact the air permeability and the moisture management capacity of a fabric. This is the reason DuPont works with a network of Nomex® Partners and the proven quality they can offer.





QUALITY ASSURANCE



DuPont™ Nomex® Partner Program

DuPont Protection Technologies has carefully selected **value chain partners** who are committed to delivering **controlled quality products** to the wearers.

The value chain covers all levels, from the fibre production at the DuPont manufacturing plant to the garment manufacturing, to ensure excellent quality personal protective clothing and to guarantee superior thermal protection.
The quality promise of products made with Nomex® fibres and fabrics is visible to the end-user through the Nomex® labelling program.
Requirements developed in the DuPont™ Nomex® labelling program go beyond the requirements of European thermal standards and ensure that the Nomex® personal protective clothing selected will retain its quality over the lifetime of the product.

The garments also undergo a visual inspection covering design, sewing quality, closure system, etc.

DuPont™ Nomex® PARTNER



COST EFFECTIVENESS OF PURCHASE

Durability, ease of care and life cycle cost

The cost effectiveness of the purchase of protective clothing is influenced by 3 factors:

1. Durability

A wash study (in accordance with the ISO 15797 test for industrial washing, drying and finishing of work wear) was conducted at an external laboratory, commissioned by DuPont.
The study assessed the durability of 3 DuPont™ Nomex® fabrics and 4 cotton and cotton blended fabrics which were treated with flame retardant chemicals.

The Nomex® fabrics were washed 200 times, the cotton and cotton blended fabrics 50 times, which is the manufacturer's suggested lifecycle for these types of fabrics.

Uniforms worn in a military environment are subjected to abrasion, heavy tear and tensile breaking forces. As a result strong fabrics have the potential to significantly improve the life cycle cost of the uniform.

Throughout the wash study, all fabrics were subjected to mechanical resistance and dimensional stability tests, looking at the effects of intense washing on:

- tear strength (according to ISO 4674), which measures the resistance to the propagation of an existing tear (i.e. the possible widening of holes in a fabric)
- tensile breaking strength (according to EN ISO 13937), which tests the resistance of a fabric to ripping
- abrasion resistance (Martindale abrasion resistance test EN ISO 12947), measuring the resistance of a fabric to rubbing on its surface
- a dimensional stability test, to assess the shrinkage of a fabric (ISO 3750)
- aesthetics over time

Test results

- DuPont™Nomex® fabrics maintain their exceptional strength throughout their entire wear life, even after 200 washes, whereas cotton and cotton blended fabrics significantly lose mechanical strength, after only 50 washes
- Nomex® fabrics also maintain their dimensional stability, even after 200 washes, FRT (flame retardant treated) cotton and cotton blended fabrics showed significant shrinkage, after just 50 washes
- Nomex® fabrics maintain their excellent appearance, the original colours remaining stable





2. Ease of care

Garments made of DuPont™ Nomex® fibres are suitable for home or industrial laundering and dry-cleaning, have a wrinkle free appearance and do not require ironing after washing.
Garments made of Nomex® fibres allow for easy removal of soil and stains (stain release finishes can be applied to the fabric to help enhance this).
Full washing and drying recommendations are printed on every Nomex® garment hang-tag.

3. Lifecycle cost: purchase price and cost per wear

The purchase price of a garment made of Nomex® fibres is higher than that of a typical garment made of cotton or cotton blend, treated with flame retardant chemicals. This purchase cost can be offset against the higher average number of washings that the garment will undergo during its lifetime, making the cost per wear of a typical Nomex® garment up to 45% cheaper than its cotton counterpart. Also the cost of a washing cycle is lower as Nomex® garments are lighter and therefore more garments can be washed within the same cycle and Nomex® dries fast with a low amount of drying energy.

DuPont is the inventor and the world's largest producer of high-performance protective materials and solutions with leading world brands such as DuPont™ Nomex® , Kevlar® ,Teflon® and Tyvek® , providing personal protection, be it thermal, mechanical or chemical. DuPont developed leading edge flash-fire and high-temperature testing technologies, including Thermo-Man® , Molten Metal Man and Arc-Man® , contributing to the development of industry norms and standards.

The DuPont Oval, DuPont™ ,The miracles of science™, Nomex® , Kevlar® ,Teflon® ,Tyvek® , Thermo-Man® and Arc-Man® are registered trademarks or trademarks of E.I. du Pont de Nemours and Company or its affiliates.

© Copyright 2011 E.I. du Pont de Nemours and Company. All rights reserved.

Product safety information is available upon request.
This information corresponds to our current knowledge on the subject. It is offered solely to provide possible suggestions for your own experimentations. It is not intended, however, to substitute for any testing you may need to conduct to determine for yourself the suitability of our products for your particular purposes. This information may be subject to revision as new knowledge and experience becomes available. Since we cannot anticipate all variations in actual end-use conditions, DuPont makes no warranties and assumes no liability in connection with any use of this information. Nothing in this publication is to be considered as a license to operate under or a recommendation to infringe any patent right.

DuPont International Operations Sàrl
DuPont Protection Technologies
Chemin du Pavillon 2, PO Box 50
CH-1218 Le Grand-Saconnex, Switzerland
Telephone Western Europe (local toll-free): +800 3876 6838
Telephone Europe, Middle-East and Africa: +34 985 12 3773
www.nomex.com
www.kevlar.com

L-14588