

Personal Protective Equipment (PPE) made of **NOMEX**[®] Information about Selection, Use, Care And Maintenance (SUCAM)

Selection of colour

To dye **NOMEX**[®] with acceptable colour fastness of 4 or even better, needs some technical know-how and is not easy. The higher proportion of KEVLAR[®], the more difficult the dying process; therefore **NOMEX**[®] Outershell Tough is generally dyed by the more expensive procedure of fibre dying, different from piece-dying process. Of course all other types of **NOMEX**[®] may also be fibre-dyed if the charge is of sufficient size.

If **NOMEX**[®] Comfort is fibre-dyed, the core fibre P 140, responsible for antistatic properties, remains undyed because it will be added first in spinning and after dying process. In order to avoid grey lines or shadows, P 140 fibre can be over-dyed later. Comparing offers, special attention should be paid on the type of dying, and also if P 140 has been over-dyed or not. That is not only a question of appearance but also of price.

The number of fibre-dyed colours are limited because this process needs a much bigger charge than the cheaper piece-dying procedure.

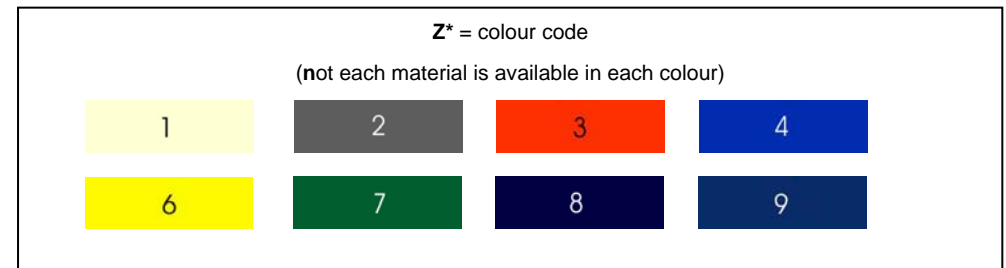
Piece-dyed fabrics reach a colour fastness that is generally one degree or point lower than fabrics woven from fibre-dyed yarns.

Considerable lower minimum charges, lower prices, generally shorter delivery terms, and automatical dying of P 140 fibre are the advantages of piece-dyed fabrics.

Independent on the technique of dying, all colours will fade following to intense, long term or frequent exposure to UV radiation.

Therefore all PPE should be protected against influence of UV radiation; refer to later information about storage.

Examples of colours



Ecru (1), orange (3), royalblue (4) and navyblue (8) are standard colours, other colours, e.g. grey (2), yellow (6), green (7), sunsetblue (9) or others may be dyed if appropriate charge will be ordered.

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Personal Protective Equipment (PPE) made of **NOMEX®** Information about **SUCAM** (continued)

Since 1968 ALWIT manufactures protective clothing made from **NOMEX®**, and has been therefore probably the first company in Europe which worked on it.

Use

The most important types of **NOMEX®** family are explained below:

Brand name	Previous brand name	Composition	Application
NOMEX® Outershell Tough	NOMEX® Delta T	75% meta-aramide, NOMEX® 23% para-aramide, KEVLAR® 2% carbon fibre, P 140	Firemen: EN 469
NOMEX® Comfort	NOMEX® Delta C	93% meta-aramide, NOMEX® 5% para-aramide, KEVLAR® 2% carbon fibre, P 140	Industry: EN 531 Firemen: Station uniform and EN 469
NOMEX® III	NOMEX® III	95% meta-aramide, NOMEX® 5% para-aramide, KEVLAR®	Industry: EN 531
NOMEX® Basicwear		50% meta-aramide, NOMEX® 50% FR Viscose	Industry: EN 531 Firemen: Station uniform, Lining in multilayer garments

NOMEX® III is also available either with 1% blend of stainless steel fibres or 2% of carbon fibre P 140; blend by P 140 (**NOMEX®** III A) it replaces the previous type **NOMEX®** Delta A.

ALWIT is specialized on **Personal Protective Equipments (PPE)** made from **NOMEX®** Outershell Tough and **NOMEX®** Comfort, as well as **NOMEX®** Basicwear for linings, as these materials cover the whole range of applications.

ALWIT develops and manufactures PPE on the base of European Directive 89/686 EC and European Standards under a certified **Quality Management System (QMS)** according to ISO 9001:2000. **BSHR (Basic Safety and Health Requirements)** as required in Annex II of the Directive are considered, especially by careful selection of materials and cut and design of garments.

Moreover ALWIT signed Dupont's contract of **NOMEX® Quality Programme (NQP)** where additional tests are executed by Dupont after the PPE has been certificated by a Notified Body. Origin of the materials and accessories shall be checked, e.g if sewing thread is also made from **NOMEX®**. Additional tests which are not always requested in standards are foreseen, obligatory the whole garment test on THERMOMAN, and optionally the test of COMFORT and ARCMAN, as far as applicable.



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Information about **SUCAM** (continued)

NOMEX® offers

Protection

- inherently flame retardant, Burning behaviour acc. EN 532 / 533 Index 3
- resistant up to approx. 350 °C
- insulating
- antistatic (depends on type *)

Comfort

- lightweight (150 – 265 g/m²)
- breathable
- no skin irritation

Life span

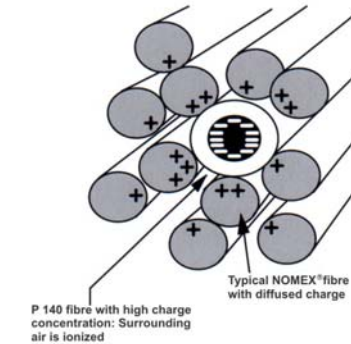
- no shrinkage
- abrasion strength
- tensile strength
3-15ply strength compared to other materials
- washable at 90 °C without lost of properties

Tensile strength (N)

	warp	weft
NOMEX® DeltaT™ 195 g/m ²	1300	1230
NOMEX® III 265 g/m ²	1400	1200
Aramid/ FR-Viskose 250 g/m ²	1206	704
FR cotton 375 g/m ²	1000	700

* Antistatic properties may be provided either by a blend of stainless steel or carbon fibres; the share of antistatic fibres should however at least 2%. The advantage of carbon fibres is based on the fact that electrical charge may be discharged by induction without leading to conductive materials. Therefore such PPE may be worn by electricians, too.

Antistatic

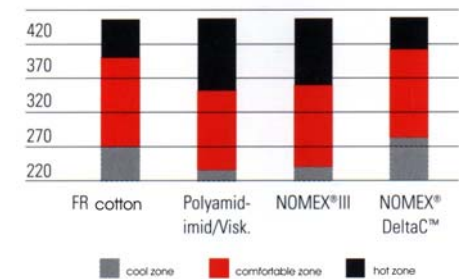


Due to the low weight **NOMEX®** does not properly protect against splashes of molten metal except a double layer PPE is used.

Therefore it is recommended to select double or even three layers of **NOMEX®** whenever necessary following to a risk assessment, e.g. protection against electric arc. Within multilayer conception it is accepted that the outer or even intermediate layer will be damaged but the inner layer will still protect.

Thermal comfort limit

Metabolic rate (W/m²)



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THERMOMAN testing procedure

How protective properties depend on the right selection of material is shown on the graph as result of THERMOMAN testing.

It can be seen that **NOMEX®** protects clearly better against burn injuries than other common materials.

	Degree of burn
NOMEX® III 265 g/m ²	40%
Cotton 375 g/m ²	75%
Polyester/Cotton 180 g/m ²	98%

Test parameter: exposure time 4 s, worn in addition of short cotton underwear, all garments of identical cut and size

Same or similar result has been won when tested according to ISO 17492, the so called **TPP** – Test (Thermal Protective Performance) used in USA, where specimen are exposed to a heat source of 50% radiant and 50% convective heat.

Test for thermal protection (TPP-Test)

	t(2)	TPP	FFF
NOMEX® Comfort 220 g/m ²	7.6	15.2	6.9
Cotton 320 g/m ²	4.5	9.0	2.8

The first column (t₂) shows there the time in seconds until 2. degree burn injuries, and the second column (TPP) the measured heat flux in cal/cm². The third column (FFF) finally relates TPP value to the weight of material.



TPP test

Maintenance

Because the high strength of **NOMEX®**, PPE sewn with **NOMEX®** thread are not susceptible for repairs. ALWIT put very much attention to mechanical performance of her products, and therefore the beginning and ending of all seams, especially at pockets, zippers and touch and close fasteners are additionally secured by bar-tacks.

Of course PPE may be exposed to extreme stress situations that might damage even such a strong product.

In that case repairs should be done by a competent company, which is using the applicable materials, if not by ALWIT herself. Fabrics and sewing thread are available by ALWIT, even in small quantities.

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Information about SUCAM (continued)

Care

General

PPE made from **NOMEX**[®] may be either washed or dry cleaned.

In any case PPE made from **NOMEX**[®] shall be washed or cleaned separately from any other clothing in order to avoid sediments of unknown fibres which may reduce the protection properties.

Especially the hook part of touch and close fasteners may affect the surface of clothing during washing procedures and may create unwanted pilling. It is therefore recommended to cover carefully all touch and close fasteners before washing. This can be done either by closing of all fasteners or by covering of the fasteners with corresponding counterparts.

Washing procedure

The following instructions apply to domestic as well as industrial washing. Since contamination might be moved to the private area, and because the lack of efficient re-impregnation during domestic washing in case of oil and water repellent properties, however, industrial washing is recommended.

Load of washing machine

2/3 of volume of the drum in order to avoid crumples.

Washing programme

Pre-washing at temperatures up to 60°C with a washing bath relation of 1:10.
Main washing at temperatures up to 60-95°C with a washing bath relation of 1:10.

Detergents

To wash PPE in a correct way, the bath should have a ph-value <10.
Generally usual commercial detergents for coloured clothing should be used which should be proportioned according to the detergent manufacturers' information. Full detergents contain brighteners and are therefore not suitable.
Do not use bleaching agents or products which contain bleaching agents.
Do not use softener.

Rinsing

After washing PPE shall be rinsed carefully in order to delete all remains of alkaline and/or possibly flammable residues of the detergent. 2-3 rinsing cycles are recommended.

Note: Usual washing programmes for coloured clothing have 3 rinsing cycles, sufficient to liberate the clothing from residues of detergents.

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Re-impregnation

Where a present oil- and dirt-repellent impregnation may lose the properties after a certain number of washing cycles, such PPE should be re-impregnated in order to improve the care and to receive better protection and lifetime. One of the most important protective property of such impregnation is also to avoid the wicking effect when exposed to flammable liquids.

Impregnation by fluorocarbonate is recommended during the last rinsing cycle with additional heat treatment by tumbling afterwards.

The effect of fluorocarbonation usually will decrease after 10 washing cycles; to avoid not-controlled loss of properties and unnecessary work of organisation, we recommend **re-impregnation after each washing**.

How can be checked if the oil- and dirt-repellent impregnation shall be renewed?

Keep the surface of the outershell fabric of PPE under current water; if the water runs off, the impregnation is still useful. If the water enters or even penetrates the fabric, the impregnation should be renewed as described above.

Drying

PPE made of **NOMEX®** may be spin-dried and dried in a cylinder drying machine with a temperature up to 130°C (80°C at cylinder exit) until a remaining humidity of 10-20%.

Note: When oil- and dirt-repellent impregnated, a remaining humidity of ~2% is recommended. That means a slight over-drying, because the effect of the fluorocarbonate film will be optimal under those conditions.

Ironing

PPE made of **NOMEX®** may be ironed with the highest temperature (3 points) without steam.

Dry (chemical) cleaning

Chemical drying is recommended when clothing became very dirty by e.g. oil or grease.

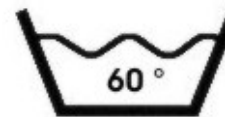
Dry cleaning shall be done according to the care labelling by usual 2-bath-procedure. Boosters should only be used in extreme situations and only with reduced mechanism.

Dry cleaning shall only be executed by experts.

Before PPE is re-used it shall be completely free of solvents.

Therefore the clothing should ventilate at least for one day after being cleaned.

Please follow the instructions on the care label which is sewn inside of the PPE.



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Storage

In order to avoid colour fading and lost of strength the PPE should not be stored under direct sunlight or other UV-light sources; heat and flame protection, however, will not go lost by the influence of UV-radiation.

PPE has to be stored in dry and dustfree conditions.

During a long lifetime of PPE a high degree of responsibility is needed by the user to check regularly the functionality of all layers of PPE, and to remove it from service if necessary.

Disposal

NOMEX® is not hazardous waste and therefore may be disposed either on dumps or in destructor stations. Contaminated clothing, however, may be hazardous waste depending on the type of contamination.

When properly cleaned, removed PPE may be recycled.

If there are any further questions regarding use or maintenance of our PPE, please do not hesitate to contact us.

Conclusion

In a mathematical form you can say:

$$\begin{array}{rcl}
 \text{PPE made of } \mathbf{NOMEX}^{\circledR} & = & \mathbf{Safety} \\
 & + & \mathbf{Efficiency} \\
 & + & \mathbf{Comfort} \\
 & = & \mathbf{Quality}
 \end{array}$$

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Accessories

Today not only CI-clothing (Corporate Identity) is fitted with different types of accessories and applications but also PPE against heat and flame. From the small identification label on the chest, via some bigger indications of department, until big company logo on the rear can be found on PPE. The procedures of fixing are even as different as the contents

- woven label, sewn on
- woven label, patched on
- embroided label, sewn on
- outershell material directly embroided
- detachable label on velcro
- screen print on outershell material
- sealing film on outershell material etc.

Each of all may change the properties of the PPE.

It can not be excluded that the requirements of a European Standard e.g. EN 531, especially the requirement for limited flame spread, are not more fulfilled. Considering this aspect seriously, each type of application requires another approval and certification by a Notified Body.

Risks resulting from the use of accessories or applications are of various nature.

- (a) Applied label may burn and endanger the unprotected head of wearer by the flame spreading to the top.
- (b) Heat developed by the burning label may penetrate the outershell material and cause burn injuries to the body.
- (c) Labels applied by screen print or sealing film may change by combination the flame retardant properties of the outershell material. Therefore the outershell material may ignite.

If the customer – for which reason ever – cannot or would not like to do without external labelling, ALWIT recommends:

1. Risk assessment made by the user should take the above mentioned aspects into consideration.
2. Applied labels or embroideries should be made from the same material as the outershell material or sewing thread.
3. If screen printed or sealed film labels are used, they should only be applied to the outer layer of a multilayer garment (e.g. on patch pockets, pocket flaps etc.).

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