DUPONT™

Product catalogue

Kevlar® | Nomex® | Tyvek® | Tychem®

DuPont Personal Protection





DUPONT PERSONAL PROTECTION

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Innovation that meets your needs

Providing professionals everywhere with the trusted personal protection they need, for the greater good of all.

For decades, DuPont innovations have helped save countless lives. DuPont scientists work tirelessly to invent new materials that are used to develop a large range of Personal Protective Equipment. These include leading brands such as Kevlar®, a world-class material used extensively in life protection ballistic systems and in hand protection, Nomex®, which makes flame and arc protection products possible; Tyvek® and Tychem®, the industry-leaders for chemical protective clothing.

Today, DuPont is combining all of this expertise and experience under one name, to create a single, powerful division: DuPont Personal Protection. This united division will make it easier for everyday heroes to find the ideal solution for their requirements, and access the right product at the right time, in the right place.

At DuPont, we understand that finding the right kind of protective equipment to meet individual market requirements isn't enough. We listened to what the market needs and realised that we have to go beyond just developing products, and so we created DuPont™ SafeSPEC™, our online tool dedicated to helping our customers find the right protective product for their specific application in chemical protection. The tool addresses every requirement, from full-body coveralls to protective gloves, and ensures that each product is performance-matched to provide a coherent and comprehensive approach to personal protection.

Our team of experts, based in Luxembourg and Geneva, run regular training sessions for our channel partners and end customers, where we share knowledge, experience and best practices. These sessions help raise awareness of the importance of PPE and how to make the right choices when selecting protective equipment.

In addition, they provide as well a duo of popular webinar series, 15'SafetyConnect and DuPont Personal Protection Webinar Academy. Both webinar streams offer safety managers an easy way to continue to build their knowledge of how to use the latest PPE technologies to reduce health and safety risks. The online format makes accessing practical training simple, helping ensure ongoing professional development at a time when in-person training might not be readily available. To learn more, visit our website: dpp.dupont.com

The protection of our environment is also a priority at DuPont. As a co-founder and member since 1995 of the World Business Council for Sustainable Development (WBCSD), DuPont seeks to be a sustainability leader in the industrial environment and is committed to using a science-based approach to our innovations and our goals.

DuPont is taking action to discover and commercialize new ways to turn unused materials into useful products or recycling them back into production for a more circular process.

> Everything we do is focused on one goal, making it easier for everyday heroes around the world to accomplish extraordinary things, this is our DuPont Personal Protection promise.

DuPont Product Range

Tychem®

Gaseous substances	**Tychem® TK**	Protection against a broad range of toxic, corosive gases, liquids and chemicals	Cat.III, Type 1a-ET
Combined chemical, heat&flame and electric arc protection	**Tychem® 6000 FR ThermoPro**	Single layer, triple-threat protection (chemical, heat & flame, electric arc) for 360° protection	Cat.III, Type 3-B, 4-B, 6-B, EN 14126, EN 1149-5, EN ISO 11612, EN ISO 14116, IEC 61482-2, EN ISO 11611
High levels of protection, compatibility with respiratory equipment	**Tychem® 6000 F FaceSeal**	Tight design combined with trusted Tychem® protection	Cat.III, Type 3-B, 4-B, 5-B, 6-B, EN 14126, EN 1073-2, EN 1149-5
Barrier technology	**Tychem® 6000 F Plus**	Tychem® 6000 F barrier in new innovative designs versions with attached gloves and/or dissipative socks	Cat.III, Type 3-B, 4-B, 5-B, 6-B, EN 14126, EN 1073-2, EN 1149-5
Integrated socks with pioneering static charge dissipative sole	**Tychem® 6000 F with dissipative socks**	Earthing made easy through adequate footwear	Cat.III, Type 3-B, 4-B, 5-B, 6-B, EN 14126, EN 1073-2, EN 1149-5
Organic and highly concentrated inorganic chemicals	**Tychem® 6000 F**	Trusted protection against a broad range of chemicals and biohazards	Cat.III, Type 3-B, 4-B, 5-B, 6-B, EN 14126, EN 1073-2, EN 1149-5
Supple protection against a broad range of inorganic and organic chemicals	**Tychem® 4000 S**	A new comfortable alternative against a broad range of inorganic and organic chemicals	Cat.III, Type 3-B, 4-B, 5-B, 6-B, EN 14126, EN 1073-2, EN 1149-5
Concentrated inorganic chemicals	**Tychem® 2000 C**	Comfortable, lightweight protection against biohazards and inorganic chemicals	Cat.III, Type 3-B, 4-B, 5-B, 6-B, EN 14126, EN 1073-2, EN 1149-5
Chemical protective tape to improve the safety level of your PPE	**Tychem® 2000 Tape**	Chemical barrier tape with Tychem® 2000 level of protection and secure adhesion. Chemical protection against inorganic acids and bases	Cat I

DuPont Product Range

Tyvek®

Superior protection against particulates and water-based chemical splashes	**Tyvek® 800 J**	The new, breathable Type 3 garment for protection against water-based inorganic chemicals under pressure	Cat.III, Type 3-B, 4-B, 5-B, 6-B, EN 14126, EN 1073-2, EN 1149-5
	Tyvek® 600 Plus	Combining Type 4 performance with the durability, protection and comfort of a Tyvek® garment	Cat.III, Type 4-B, 5-B, 6-B, EN 14126, EN 1073-2, EN 1149-5
	Tyvek® 500 Labo	Protecting wearers and processes in laboratories and clean environments	Cat.III, Type 5-B, 6-B, EN 1073-2, EN 1149-5, EN 14126
	Tyvek® 500 Xpert	Setting a new standard of protection in the Type 5 and 6 category through greater protection and comfort	Cat.III, Type 5-B, 6-B, EN 14126, EN 1073-2, EN 1149-5
	Tyvek® 500 Xpert (Eco Pack)	DuPont™ Tyvek® 500 Xpert now available in a new, more sustainable packaging solution - a significant waste reduction compared to standard Tyvek® 500 Xpert coverall	Cat.III, Type 5-B, 6-B, EN 14126, EN 1073-2, EN 1149-5
	Tyvek® 500 HP	Solution for wearers needing chemical protection when working at heights.	Cat.III, Type 5-B, 6-B, EN 14126, EN 1073-2, EN 1149-5
	Tyvek® 500 Industry	Protection for workers and their products, in sensitive industrial environments	Cat.III, Type 5, 6, EN 1073-2, EN 1149-5
	Tyvek® 500 HV	All-in-one solution: high-visibility (to the highest class), chemical, biological and antistatic protection in one coverall	Cat.III, Type 5-B, 6-B, EN 14126, EN 1073-2, EN 1149-5, EN ISO 20471, RIS-3279-TOM Issue 1 (replaces GO/RT 3279 Issue 8)
	Tyvek® 400 Dual	Protection and durability in the front breathability in the back	Cat.III, Type 5, 6, EN 1073-2, EN 1149-5
	Tyvek® 400 DualFinish	Front that reduces the risk to stick or delaminate when exposed to tacky resins, comfort in the back	Cat.III, Type 5, 6, EN 1149-5
	Tyvek® 400 DualCombi	For environments where comfort is important and exposure risk limited to front	Cat.III, Type PB[6]
Good protection against particulates and water based chemical splashes	**Tyvek® 200 EasySafe**	Great breathability and optimised protection for less demanding applications	Cat.III, Type 5, 6 EN 1073-2, EN 1149-5

DuPont Product Range

Tyvek® IsoClean®

People, process and product protection for controlled environments	**Tyvek® IsoClean® clean-processed and sterile range**	Suitable for GMP A&B, ISO 4/5 controlled environments	Please check product details
	Tyvek® IsoClean® sterile range	Suitable for GMP A&B, ISO 4/5 controlled environments	Please check product details
	Tyvek® IsoClean® non-sterile range	Suitable for GMP C&D, ISO 6/9 controlled environments	Please check product details

DuPont Product Range

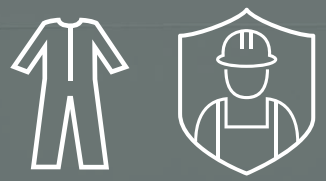
ProShield®

Limited particulate and liquid protection	**ProShield® 60**	Best in class microporous film at a highly economical price	Cat.III, Type 5, 6, EN 1073-2, EN 1149-5
Flame retardant, limited particulate and liquid protection	**ProShield® 20 SFR**	The solution to protect you and your flame-resistant workwear underneath	Cat.III, Type 5, 6, EN 1073-2, EN 1149-5, EN ISO 14116
Limited particulate and liquid protection	**ProShield® 20**	Based on SMS technology, breathable lightweight coverall for entry-level Type 5, 6 protection	Cat.III, Type 5, 6, EN 1073-2, EN 1149-5
Non hazardous substances	**ProShield® 8 Proper**	Durable, washable and comfortable garment ideal for general maintenance activities	Cat.I

Garment selection: A life saving choice

There are many different chemical protective suits commercially available, and although they are CE certified, there are very wide ranging performance differences for products meeting the same certification 'Types'. Faced with a bewildering choice and the complexity of the certification information, what criteria should be used to select the right protective clothing?

A short summary of the European standards for chemical protective clothing and a chemical protective clothing selection guide is provided to assist you in this task.



CE

CE Marking

To facilitate the choice of garment, the European Union has defined harmonised product standards for six levels of protection (referred to as 'Types') within Category III chemical protective clothing (see table below). The certification of a suit to a particular protection type represents its overall tightness against a particular form of exposure (gas, pressurised liquids, sprays and dust).

It should be noted that its certification does not necessarily mean that the suit is 100% impervious to this type of exposure. It only means that the suit meets the minimum requirements of the specific product standard. The manufacturer is also obliged to state the performance levels of the constituent materials and seams, known as performance 'Classes'.

Garment selection: A life saving choice

CHEMICAL PROTECTIVE CLOTHING, CATEGORY III

Pictogram*	Type	Definition and Exposure Level	Product Standard and Year of publication
	TYPE 1 TYPE 1 - ET	**GAS-TIGHT** TYPE 1 – Protective clothing against liquid and gaseous chemicals, including liquid aerosols and solid particles. TYPE 1 - ET – Performance requirements for emergency teams.	EN 943-1:2019** EN 943-2:2019
	TYPE 2	**NON-GAS-TIGHT** Protective clothing against liquid and gaseous chemicals, including liquid aerosols and solid particles.	EN 943-1:2019**
	TYPE 3	**LIQUID TIGHT** Protective clothing against liquid chemicals. Exposure to pressurised jet of liquid.	EN 14605:2005/A1:2009
	TYPE 4	**SPRAY TIGHT** Protective clothing against liquid chemicals. Exposure to a liquid spray aerosol (unpressurised).	EN 14605:2005/A1:2009
	TYPE 5	**SOLID PARTICULATES** Protective clothing against solid-airborne particulates.	EN ISO 13982-1:2004/A1:2010
	TYPE 6	Limited protective performance against liquid chemicals Potential exposure to small quantities of fine spray/mist or accidental low volume splashes and where wearers are able to take timely adequate action in case of contamination.	EN 13034:2005/A1:2009

* DuPont Pictogram. ** Amended in 2005.

Garment selection: A life saving choice

OTHER RELEVANT STANDARDS

Pictogram*	Definition	Standard and Year*
	Protective clothing with electrostatic properties – material performance and design requirements.	EN 1149-5:2018
	Protective clothing against radioactive contamination.	EN 1073-2 :2002
	Protective clothing with protection against heat and flame-Limited flame spread materials, material assemblies and clothing. Three 'Index' (levels) of protection are defined Index 1 performance: single use and no pre-cleaning or laundering. Index 1 materials limit the flame spread, but will melt and must always be worn on top of Index 2 or 3 garments.	EN ISO 14116:2008
	Protective clothing (fabrics) against infective agents (indicate by a 'B' e.g. Type 3-B) and comprising several fabric protection test methods.	EN 14126:2003
	High-visibility clothing - Test methods and requirements.	EN ISO 20471:2013

* As standards are continuously revised the year of publication is subject to change. ** Antistatic treatments on DuPont chemical protective clothing are only effective in relative humidity >25% and when the garment and wearer are continuously and correctly grounded. *** Does not protect against ionizing radiation.

THE 9-STEP GUIDE
from DuPont to garment selection

Faced with a huge array of potential hazards, a bewildering choice of protective clothing and the complexity of the certification information, what criteria should be used to select the right protective clothing?

This Selection Guide and the ensuing sections provide you with a summary of the European Standards for Personal Protective Equipment (PPE) and further information on which to base your decisions.

Workers can potentially be exposed to a multitude of workplace and environmental hazards. These include asbestos, dioxins, oils, lubricants, paints, blood and biological hazards, nuclear, phytosanitary products, organic chemicals, heat and flame risks and there are many different factors such as concentration, temperature, pressure that can have a significant influence on the risks posed by these threats. In addition, the physical nature of these threats can take many forms including liquid, gaseous, fine dusts, solid particles, fibres, sprays, aerosols, splashes and radioactive particles. Furthermore, in many workplace environments there are multiple protection requirements that need to be considered and, of course, every hazard environment and every exposed person is different. Which means that the choice of protective clothing has to take into account a host of physiological and psychological factors that combine to influence a garment's effectiveness and its 'wearability' in 'real life' exposure situations.

The fact that all of these complicated and interactive factors must be considered as a whole makes the selection of the optimum protective clothing an extremely difficult and daunting task. To ensure that all the appropriate precautions are taken requires thorough workplace risk assessments to be conducted at periodic intervals to ensure the short term safety and/or long-term health and well-being of the workers.

This process of selecting, and regularly reviewing, protective clothing that is safe, effective and comfortable is an extremely important task and should never be overlooked or undervalued.

Within the context of an overall risk analysis **9 STEPS** presented on the next page, should be followed (in alignment with national legislation / recommendations) to arrive at the most appropriate protective clothing.

IMPORTANT: If you are new to protective clothing and do not know exactly which garment(s) you need, or if you require further information on garment selection please read this section first.

THE 9-STEP GUIDE
from DuPont to garment selection

STEP 1

Hazard identification



STEP 2

Determine minimum levels of protection needed



STEP 3

Assess hazard toxicity



STEP 4

Determine protective performance requirements of the fabric and seam



STEP 5

Determine mechanical performance requirements



STEP 6

Comfort considerations



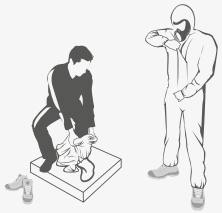
STEP 7

Supplier selection



STEP 8

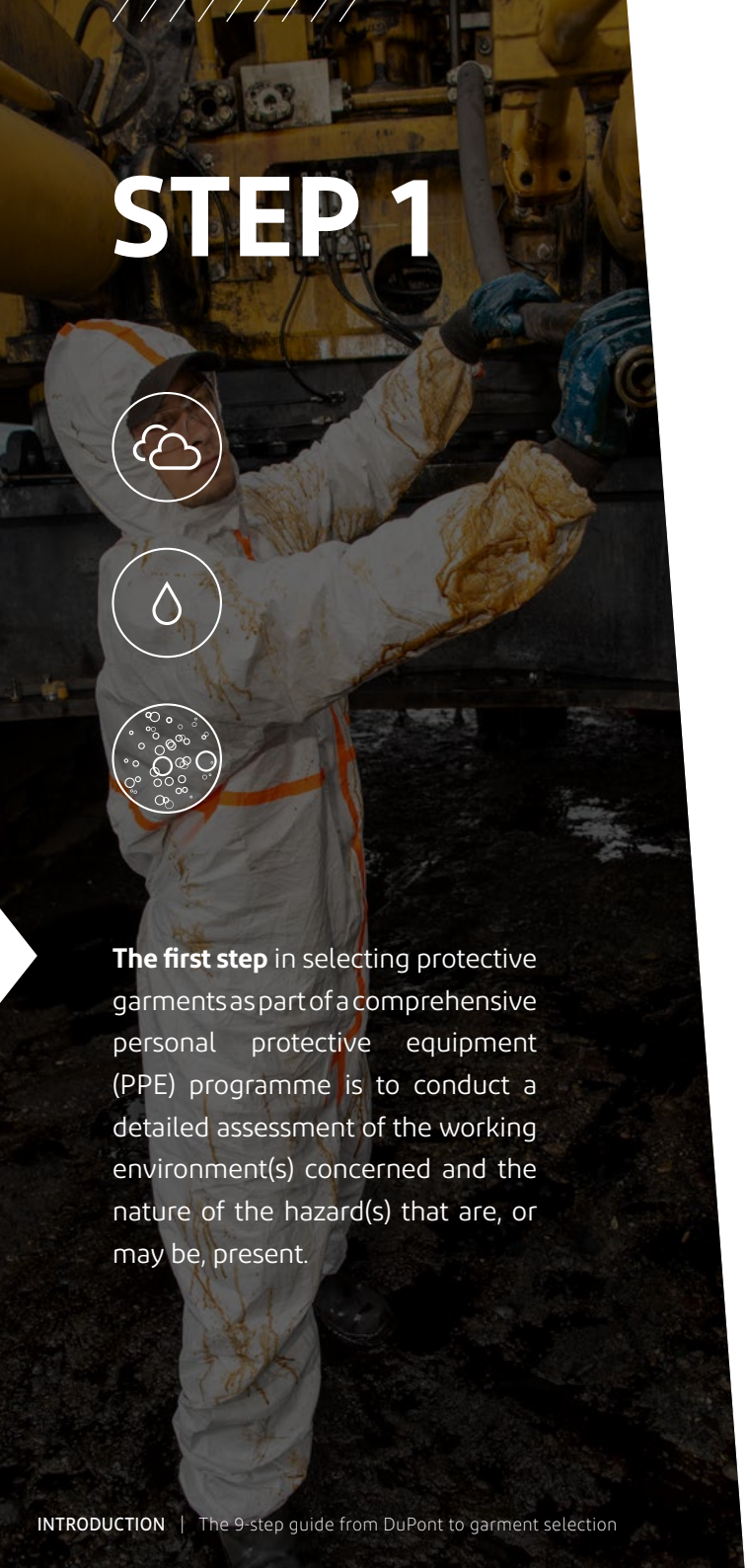
Identify the correct usage of the product



STEP 9

Wear test





STEP 1

The first step in selecting protective garments as part of a comprehensive personal protective equipment (PPE) programme is to conduct a detailed assessment of the working environment(s) concerned and the nature of the hazard(s) that are, or may be, present.

Hazard identification

This risk analysis might take the following form:

1. Objectively identify the potential hazards including their sources and any associated trigger events. A suitable hazard assessment form or software package might be used for this purpose.
2. Determine those who might be affected by exposure to a hazard and in what circumstances.
3. Evaluate the risks and what steps are available for prevention, mitigation and protection. At all times consult with operatives and their representative bodies.
4. Incorporate the findings into a formal risk assessment document which can be shared, and expanded as necessary.
5. Put the risk assessment findings into practice, and make sure you have contingency plans in place for the unexpected.
6. Continuously re-examine procedures, training and equipment as necessary and periodically conduct a formal review of the entire risk assessment programme.

As part of this exercise the following are some of the questions that need to be asked:

- What is the hazard format? Is it a gas, a liquid, a vapour or a particle?
- Could the hazard react or change physical state during exposure?
- What is the toxicity level of the substance concerned?
- What is the quantity of the substance expected to contact the garment?
- How long are the operators likely to be exposed to the hazard?
- What other PPE will be used with the garment?
- What is the temperature and humidity in the working environment?
- What is the concentration of the chemical or substance involved?
- What kind of job do the people perform and what is the risk of exposure?



STEP 2

Determine minimum levels of protection needed

In other words, determine the degree(s) of exposure level(s) to identify a potential suitable minimum garment 'CE-Type'. The designation of six separate 'Types' of protection within CE Category III chemical protective clothing is intended to facilitate the selection as a function of the nature of the hazard exposure. Certification to a particular protection Type represents the tightness of the garment against a particular form of exposure (gas, liquid or dust). However it does not mean that the item is 100% impervious to this type of exposure.



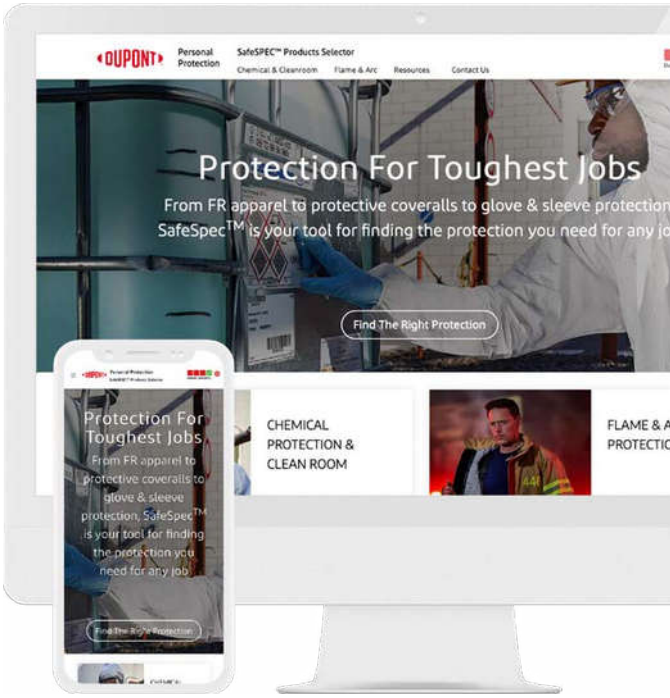
Assess hazard toxicity

Knowing the toxicity or consequences of short- or long-term exposure to a hazard is essential. With this in mind, consider whether a coverall has been tested to the following standard: EN ISO 6529 which gives information concerning the chemical permeation and penetration of the fabric where the chemical is tested up to 480 minutes and a minimum of 10 minutes. Further assistance can be accessed in the Instructions for Use attached to DuPont products packaging, where you can find permeation data for a selection of chemicals.

Detailed permeation data for over than 450 chemicals can be accessed on

SAFESPEC.DUPONT.CO.UK

DuPont™ SafeSPEC™





STEP 4

Seam construction

Seams are a critical component of the overall barrier protection provided by a chemical protective garment. It is vital to select the appropriate seam configuration for your application needs and to know that the garment will be constructed with strong, tight seams. One loose thread or gap and the barrier between you and your environment unravels—leaving you vulnerable.

Determine protective performance requirements of the fabric and seam

Fabric

No matter what the brand or trade name, almost all limited-use protective apparel products can be classified into one of a few general fabric technologies. It is important to understand the performance attributes of the fabric being used for a given application. Why? Not all fabrics used in chemical protective garments are the same. From exclusive DuPont technologies such as DuPont™ Tychem® and DuPont™ Tyvek® to SMS and microporous film fabrics, DuPont offers a variety of fabrics with different levels of comfort, durability, breathability and protection to meet your specific needs.

In order to select the appropriate protective garment, it is crucial to know how well the fabric used in the garment provides a barrier to specific hazardous materials. Testing for chemical protective fabrics can be divided into two primary categories:

1. penetration testing - appropriate for particle hazards
2. permeation testing - appropriate for liquid and gaseous hazards

Penetration occurs when there is bulk movement of a material through a pore, hole, gap or defect in the fabric and is the proper method to evaluate particle barrier. Permeation, on the other hand, occurs when there is movement of the material through the barrier fabric on a molecular level. It is possible for a liquid or vapor to permeate through a fabric even when there is no observed opening in the fabric. Permeation testing is a more sensitive and representative way of characterizing the interaction of liquids and gases with the barrier fabric. Permeation testing is critical for fabrics that are exposed to hazardous liquids, vapors or gases.



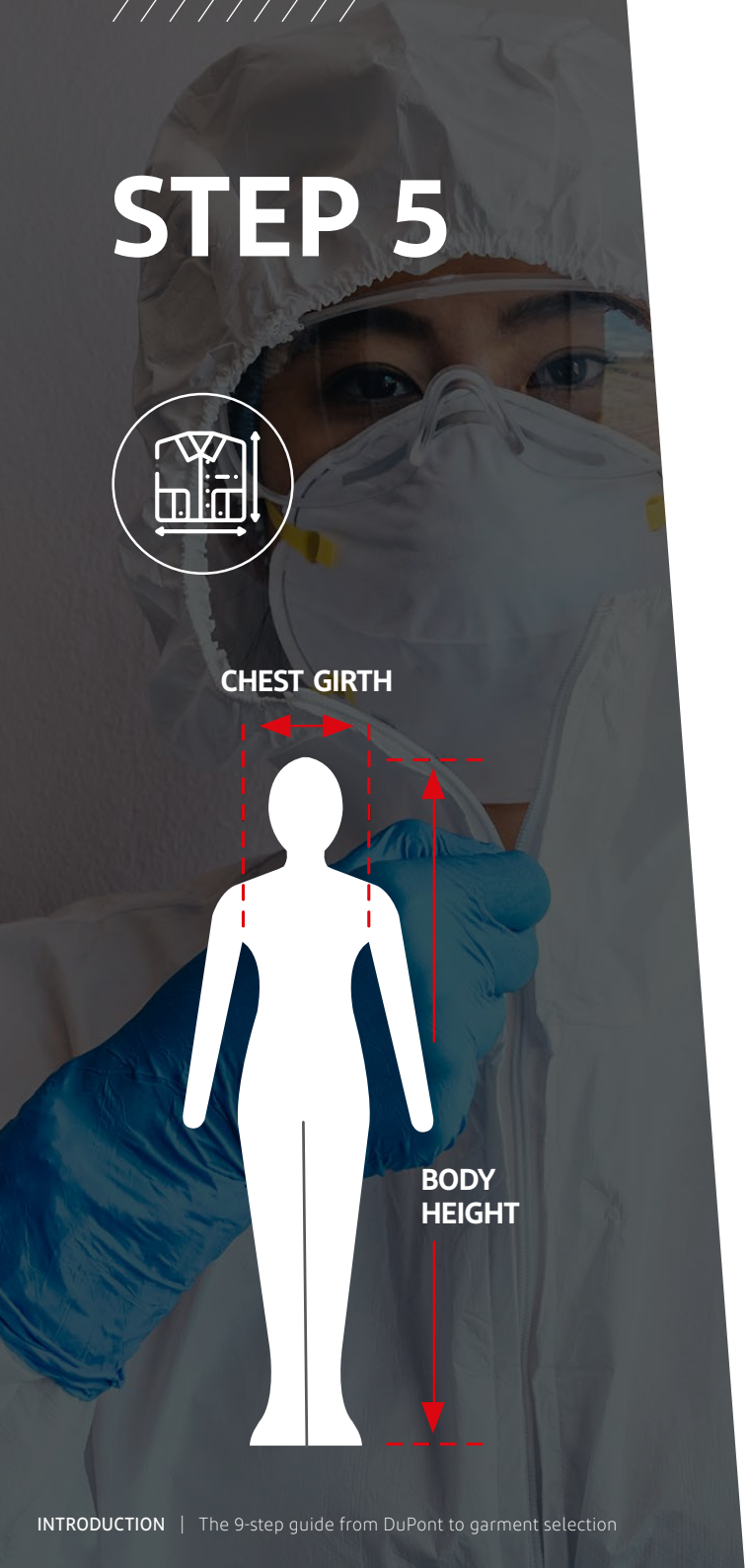
STEP 5

STEP 5

Determine mechanical performance requirements

Fabric performance is critical, but it is only as good as the integrity of the garment itself. Excellent fabric barrier properties are only of value if they remain intact for the duration of the task and can withstand the working conditions. Consequently, in addition to the requirements for barrier performance, protective clothing must be considered from a 'whole garment' perspective taking into account factors such as the fabric's mechanical properties such as strength, abrasion resistance, susceptibilityto tearing, and seam integrity. To assess these qualities it is highly recommended that all garments under consideration are subjected to wear trials under 'actual conditions' of use (please see Step 8).

Two important factors that contribute to protection-in-use (and overlap with comfort and ease-of-use considerations are garment sizing and garment fit (please see donning and doffing videos). The correct size and cut of a protective coverall has a huge impact on the protection provided to the wearer and is a significant determinant of comfort and ease of use. Garments must be available in a full range of sizes to suit different physical and gender characteristics, must be of a non restrictive, ergonomic fit, compatible with other PPE items, and yet not be so bulky as to present undue risk of snagging, tearing or tripping.



STEP 5

Determine mechanical performance requirements

BODY MEASUREMENTS CM/INCH

SIZE	CHEST GIRTH (cm)	BODY HEIGHT (cm)	CHEST GIRTH (inches)	BODY HEIGHT (feet/inches)
XXS	68 - 76	150 - 158	27 - 30	4'11" - 5'2"
XS	76 - 84	156 - 164	30 - 33	5'1" - 5'5"
SM	84 - 92	162 - 170	33 - 36	5'4" - 5'7"
MD	92 - 100	168 - 176	36 - 39	5'6" - 5'9"
LG	100 - 108	174 - 182	39 - 43	5'8" - 6'0"
XL	108 - 116	180 - 188	43 - 46	5'11" - 6'2"
2XL	116 - 124	186 - 194	46 - 49	6'1" - 6'4"
3XL	124 - 132	192 - 200	49 - 52	6'3" - 6'7"
4XL	132 - 140	200 - 208	52 - 55	6'7" - 6'10"
5XL	140 - 148	208 - 216	55 - 58	6'10" - 7'1"
6XL	148 - 156	208 - 216	58 - 61	6'10" - 7'1"
7XL	156 - 162	208 - 216	61 - 64	6'10" - 7'1"

STEP 6



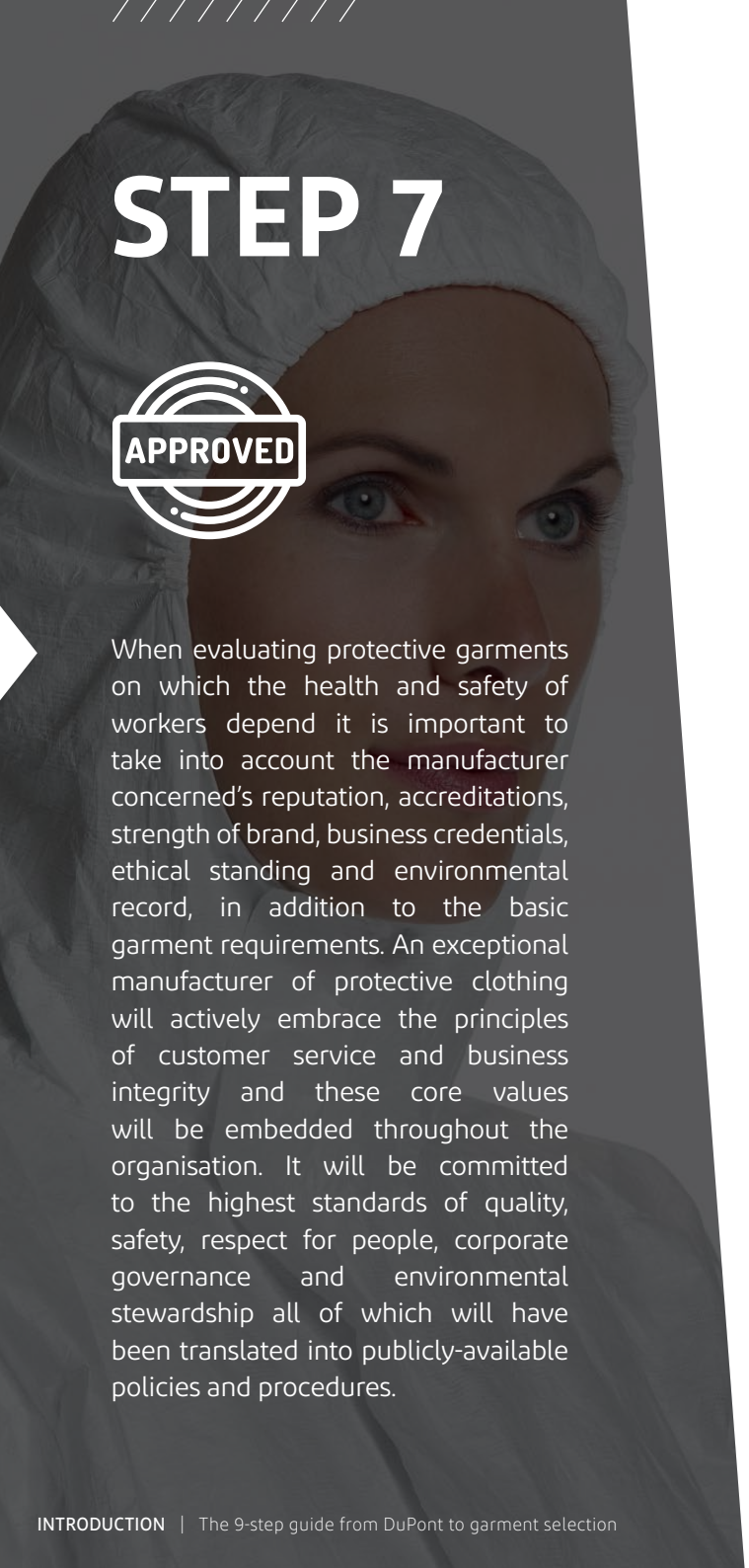
Garment style

DuPont offers a wide variety of garment styles - from hoods and shoe covers to aprons, coveralls and fully encapsulated suits. Fully encapsulated suits are available with front or rear entry, with a flat back for airline accommodation or an expanded back for SCBA accommodation.

STEP 6

Comfort considerations

Effective protection is vital, but so is wearer comfort. When it comes to 'day-in day-out' health and safety compliance, operator comfort is one of the key 'human factors' that govern the correct use of Personal Protective Equipment (PPE). The importance of wear-comfort and correct garment fitting cannot be overstated. A large proportion of observed PPE non-compliance occurrences are not due to an absence of protection but are simply due to workers shunning, misusing or abusing the protectionprovided. And even where staff are wearing the appropriate equipment, if it doesn't fit or if it isn't comfortable then it is often being worn incorrectly. Identifying the appropriate protective and mechanical performance, yet, at the same time, maximising wearer comfort is a critical part of the selection equation and will significantly contribute to correct coverall use with optimised wearer satisfaction and productivity. As with protection-in-use (please see Step 5) it is essential that donning and doffing procedures are developed and practised (Step 8) and user wear trials (Step 9) are conducted to assess the perceived comfort-in-use of the garment(s) being considered.



STEP 7

When evaluating protective garments on which the health and safety of workers depend it is important to take into account the manufacturer concerned's reputation, accreditations, strength of brand, business credentials, ethical standing and environmental record, in addition to the basic garment requirements. An exceptional manufacturer of protective clothing will actively embrace the principles of customer service and business integrity and these core values will be embedded throughout the organisation. It will be committed to the highest standards of quality, safety, respect for people, corporate governance and environmental stewardship all of which will have been translated into publicly-available policies and procedures.

STEP 7

Supplier selection

At a product level the manufacturer should ensure that in addition to the highest standards of quality, the protective garments should be free from hazardous or banned ingredients, free from SVHC's (REACH compliant), not present hazards to the ecosystem and not include skin allergens or sensitisers. Garment production facilities, whether in-house or outsourced, must embrace the principles of safety, employee welfare and social responsibility and be managed and periodically audited to ensure compliance. The manufacturer should provide a high level of pre- and after-sales service and support ideally including training programmes, testing services, selection tools, risk-analysis guidance and permeation data.

Some additional questions you might ask potential suppliers include:

- Does the company offer Customer Service support (technical support hotline, customer focused websites and tools, wear trials)?
- Does the company offer open access to product data e.g. can the company provide comprehensive permeation data for its products?
- Can it demonstrate exemplary case studies/user references?
- What is the product development process?
- Is Corporate Social Responsibility (CSR) one of the company's core corporate principles or business objectives? Does the company publish a CSR Policy or issue regular CSR reports?
- Does the company have a formal Sustainability Policy?
- Has the company publicized a Code of Conduct/Ethics?
- Is the company ISO 14001 registered for Environmental Management Systems?
- Does the company have a rigorous Quality Management System (QMS) in place and operate a Quality Management System to ISO 9001?
- What is the company's trading background?
- Is the company financially secure?
- How is the company perceived in the media?



STEP 8

Ensure proper training is provided for correct donning, doffing and usage and be aware of product limitations. Note that the manufacturer's Instructions for Use, sometimes disregarded or overlooked, can be a useful source of information on the correct use of the product and any limitations. Please make sure you answer questions, as for example:

STEP 8

Identify the correct usage of the product

- Is additional taping required e.g. to the mask, cuffs, ankles?
- Have earthing requirements been considered for the wearer and the coverall?
- Can the wearer come into contact with sharp surfaces that could damage the garment?



- Can the suit come into hot surfaces that could melt the fabric or open the seams (e.g. contact with hot pipes or steam cleaning)?
- Is a donning and doffing procedure required and does this procedure need training to avoid contamination when the garment is put on and removed?
  (please see videos)



DUPONT

Wear test

A detailed examination of technical performance data and product standards is only the first part of the product selection process. Once a product has been selected which meets the required performance criteria on paper it is then important to conduct 'in-use' wear trials to test and evaluate the product performance in use. This will include using the garments part of an appropriate PPE ensemble to ensurefull 'in-use' compatibility under expected operating conditions. In these user tryout exercises endeavour to involve as many people as possible and ask them to complete a standard evaluation form at the conclusion of the trial. Depending on the nature of the work it may be necessary to conduct these trials over a period of days or even weeks in order to evaluate the performance of the garments under live conditions but this will be time well spent if it results in the correct and most cost efficient choice of protection. Please contact your DuPont representative or distributor to get a wear-trial form.

The result will be a choice of garment that fulfils user expectations in terms of fit, function, comfort, performance, durability and, of course, safety.

Training, storage and other ongoing considerations



Procuring the correct PPE is only the first part of the equation. It then has to be stored, maintained, used correctly, disposed of and replaced. Shelf-life of the PPE should be considered to store boxes for a certain period of time. Most importantly, users must be correctly trained in its use. Employers, in addition to continually assessing workplace hazards as part of an interactive health and safety programme, must keep abreast of all technical and legislative developments relating to workplace safety and modify all safety policies and procedures as necessary.

DuPont™ SafeSPEC™

DuPont offers a range of support tools to assist with risk assessment and garment selection: ranging from web-based tools and on-site risk assessment support with DuPont Personal Protection specialists and chemists, to chemical permeation barrier testing for your specific chemicals.

SafeSPEC™, our powerful online tool, can help you determining your most suitable protective garment and glove combination among more than 1000 scenarios!

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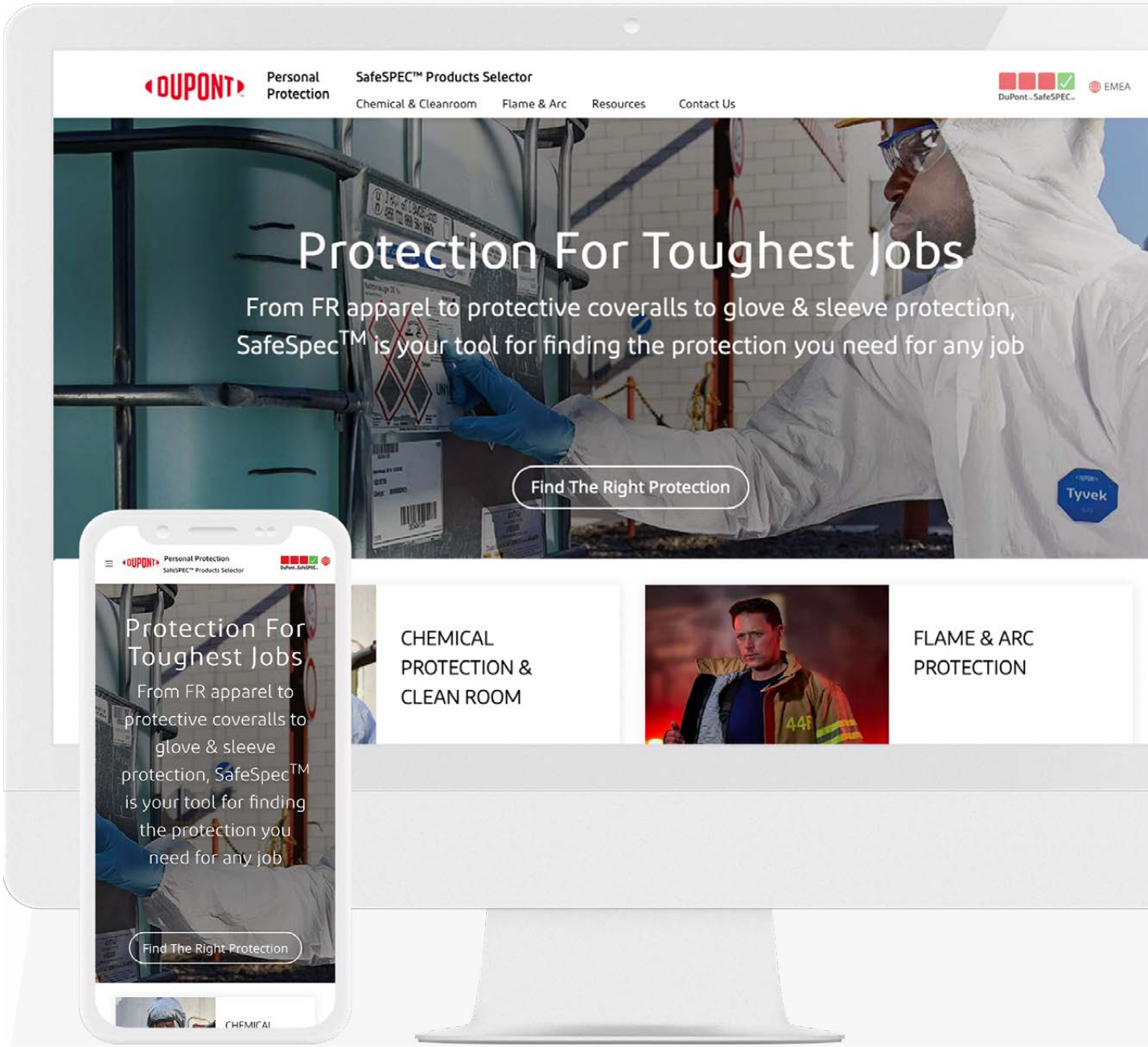


Recommended donning & doffing procedures
FOR CHEMICAL PROTECTIVE CLOTHING

Follow the steps recommended below to dress and undress in a safe and simple manner, thereby limiting any potential for contamination after working in a hazardous environment.

Typical products following this procedure:
Tyvek® 800 J, Tyvek® 600 Plus*, Tyvek® 500 Labo, Tyvek® 500 Xpert, Tyvek® 500 HP, Tyvek® 500 Industry, Tyvek® 500 HV, Tyvek® 400 Dual, Tyvek® 400 DualFinish, Tyvek® 400 DualCombi, Tyvek® 200 EasySafe

The right size for increased protection and comfort

SIZE (CM)	SM	MD	LG	XL	2XL	3XL
	84 - 92	92 - 100	100 - 108	108 - 116	116 - 124	124 - 132
	162 - 170	168 - 176	174 - 182	180 - 188	186 - 194	192 - 200

DONNING



DOFFING



* For Tyvek® 600 Plus and Tyvek® 800 J, use self-adhesive tape to seal the zipper and chin flaps.

Recommended donning & doffing procedures
FOR CHEMICAL PROTECTIVE CLOTHING

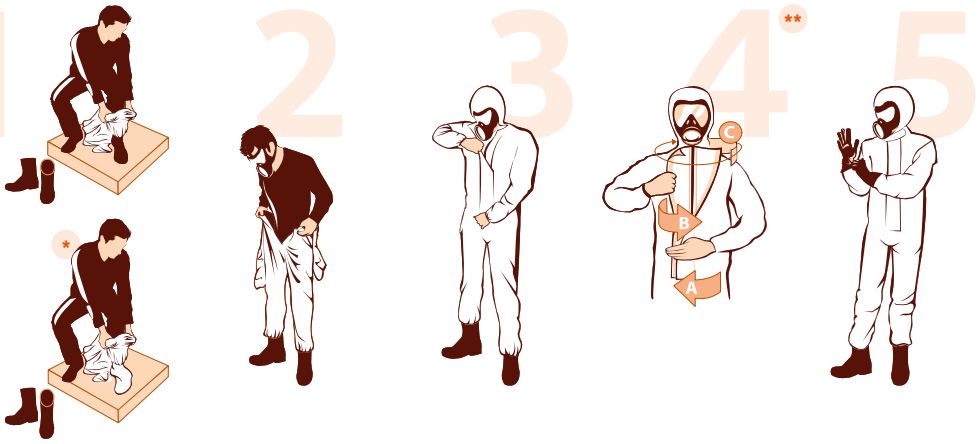
Follow the steps recommended below to dress and undress in a safe and simple manner, thereby limiting any potential for contamination after working in a hazardous environment.

The right size for increased protection and comfort

SIZE (CM)	SM	MD	LG	XL	2XL	3XL
	84 - 92	92 - 100	100 - 108	108 - 116	116 - 124	124 - 132
	162 - 170	168 - 176	174 - 182	180 - 188	186 - 194	192 - 200

Typical products following this procedure:
Tyvek® 600 Plus, Tyvek® 800J, Tychem® 2000 C, Tychem® 4000 S, Tychem® 6000 F

DONNING



DOFFING



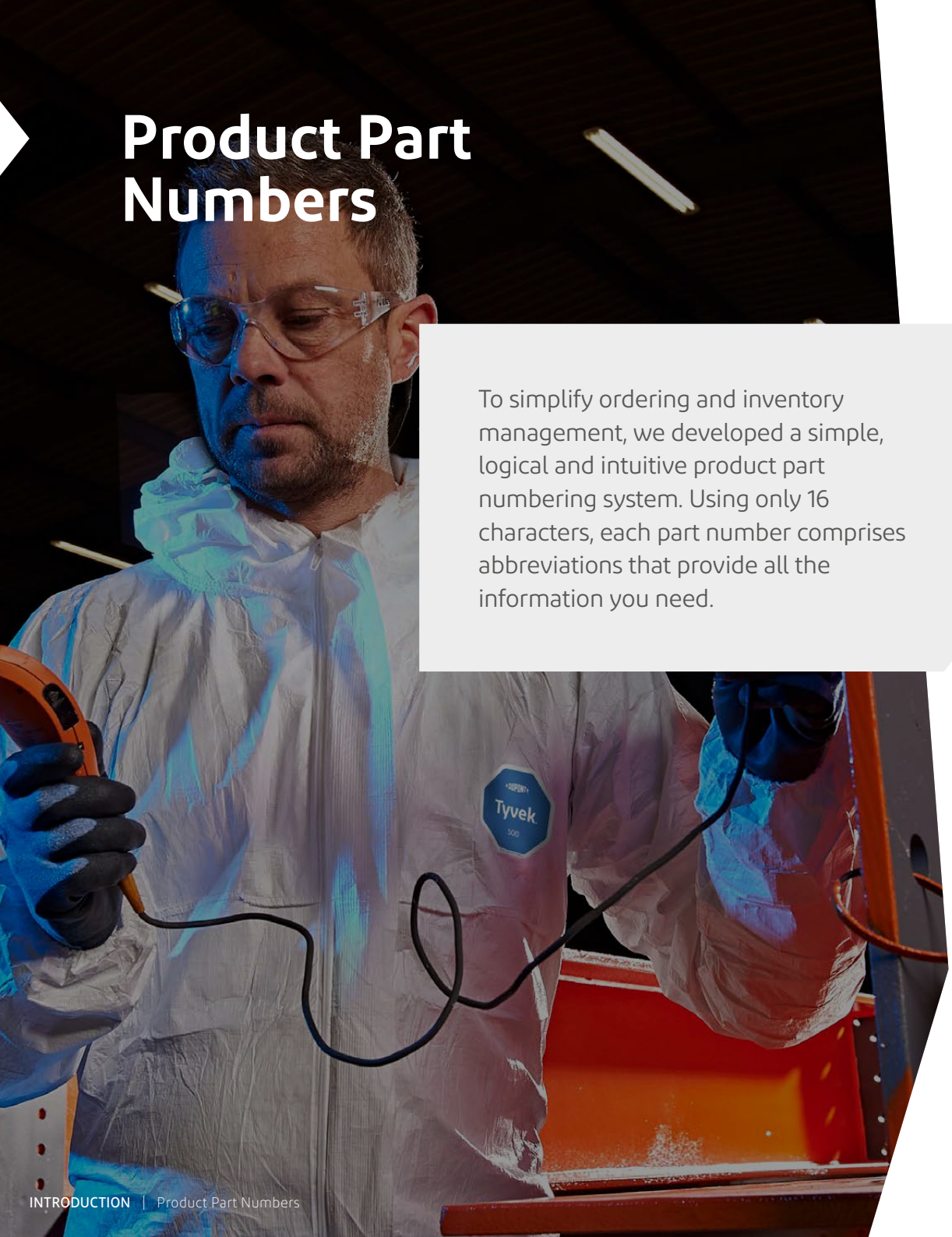
*Garment with integrated socks only
**We recommend to request second person's help to stick the flap properly, and to remove the garment without getting contaminated. In case no one can help, the use of a mirror is recommended.

Product Part Numbers

TY	120	S	WH	LG	0025	00
Fabric	**Style**	**Seam Construction**	**Color**	**Size**	**Case Count**	**Options**
The first two characters are the fabric description. *Abbreviations* DuPont™ Tychem® **TK** **TF** 6000 **TYF** 6000 **SL** 4000 **TC** 2000 **99** Accessories DuPont™ Tyvek® **TJ** 800 J **TY** 600 **TY** 500 **TY** 400 **TD** 400 D DuPont™ ProShield® **PS** 60 **PS** 20 **PS** 20 SFR **PS** 8 Proper	DuPont offers a wide array of garment styles—from hoods, aprons and coveralls to fully encapsulated suits. Each garment style has a unique three-digit code.	*Abbreviations* **S** Serged or Sewn **B** Bound **T** Taped or Double Taped See page 16 for details.	Several DuPont fabrics are available in color options. *Abbreviations* **BU** Blue **GR** Green **GY** Grey **LY** Lime Yellow **OR** Orange **WH** White **YL** Yellow **HV** High visibility Orange	Many DuPont garments are available in a range of sizes; refer to catalog descriptions for details. *Abbreviations* **SM** Small **MD** Medium **LG** Large **XL** Extra large **2XL** 2 Extra large **3XL** 3 Extra large **4XL** 4 Extra large **5XL** 5 Extra large **6XL** 6 Extra large **7XL** 7 Extra large **00** Universal See page 17 for sizing charts.	The number of garments per case.	*Abbreviations such as* **00** Standard offering **0B** Bulk pack Option codes for Tyvek® IsoClean® garments*: **DS/MS** Clean and Sterile: clean-processed, individually (DS) or multi (MS) packaged and sterilized by gamma radiation **00** or **0B** Bulk packaged

* Not all sizes are available in all styles.

Product Part Numbers



To simplify ordering and inventory management, we developed a simple, logical and intuitive product part numbering system. Using only 16 characters, each part number comprises abbreviations that provide all the information you need.

Stock Items versus Make to Order for ProShield® and Tyvek® garments, sizes Small to 3 Extra Large are identified as stock items. Sizes Extra Small and 4 Extra Large and above are identified as Make to Order. Certain accessory items are also identified as Make to Order.

Some garments in the Chemical/HazMat line (Tychem® 2000, Tychem® 4000, Tychem® 6000, and Tychem® TK) are identified as Make to Order. A small grouping is identified as stock items, following the same size guidelines as indicated above.

Make to Stock / Order designations are based on sales volume and production efficiencies. Therefore, designations are subject to change without notice.

Please refer to our price lists for more detailed information.

GARMENTS

DUPONT™

Tychem®

Garments & Accessories



& ACCESSORIES

Back to summary

Tychem® TK

Effective barrier against more than 300 chemicals for your peace of mind.

Specifically developed to protect against toxic and corrosive gases, liquids and solid chemicals.

Fabric, visor, inner layer glove and seams meet required resistance to permeation for chemicals listed in EN 943-2.

Out of the 300 chemicals tested, no observable breakthrough in tests for 270 chemicals after 8 hours of exposure.

Puncture- and tear-resistant.

Oil and gas

Emergency response

Chemical industry

Reference:	TYK GEVHD YL 00 (WITH SOCKS) TYK GEVJD YL 00 (WITH BOOTS)
Colour:	Lime yellow or Lime green
Size:	SM to 2XL (ALL SIZES ARE MTO) Available boot sizes EU size 35 - 50

MTO = Made to order.



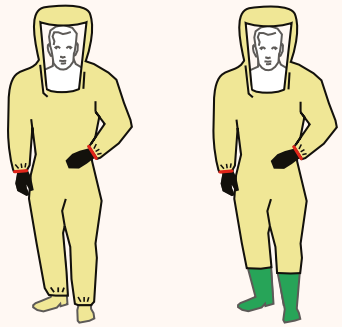
Gas-tight zip closure



Attached gloves



Option: hazmat chemical boots





Category III

TYPE 1a -ET

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Tychem® 6000 FR

THERMOPRO TP0198T

Single layer, triple-threat (chemical, thermal and electric arc) protection garments and accessories for 360° protection.

Synergy of two unique and long-proven technologies from DuPont: **Tychem®** for the chemical protection and **Nomex®** for the heat and flame and electric arc protection.

Protection against organic and inorganic chemicals. Tested for permeation against > 240 chemicals.

Tested on DuPont™ Thermo-Man® thermal mannequin: up to 8% predicted body burn injury for an average of 98% chances of survival in case of a flash fire.

Electric arc rating: ATPV = 15 cal/cm².

Single layer allowing a great scope of movement.

Can be reused if not contaminated or damaged.

Oil and gas

Emergency response

Chemical industry

Reference:	TP 0198 T OR CE
Colour:	Bright orange
Size:	SM to 4XL (SIZES SM AND 4XL ARE MTO)

MTO = Made to order.



Hood with tight fit to face mask



Flame retardant draw strings



FR Neoprene elasticated wrists





Category III

TYPE 3*

TYPE 4*

TYPE 6*

EN 1149-5

EN 14126

EN ISO 11612 A1 B1 C1 D1 E2 F2

EN ISO 11611

IEC 61482-1-2

EN ISO 14116 Index 3

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Tychem® 6000 FR

NEW

THERMOPRO TP0275T

SLEEVED APRON

Sleeved gown available in bright orange for high visibility. The new design of the gown extends to the ankles and fully closes in the back with adjustable FR buckles at back of waist and shoulders.

Integral sleeves with FR Neoprene elastic on the wrists. Mandarin collar. Sewn with DuPont™ Nomex® thread Tychem® 6000 FR ThermoPro accessories provide partial body protection (Cat. III PB[3]) and must be used in conjunction with primary flame resistance clothing that is rated for the fire/arc hazard. Typical applications include use in academic and professional laboratories.



Mandarin collar



Two buckle closure system



FR Neoprene elasticated wrists



Category III

TYPE PB[3]*

EN 1149-5

EN ISO 11612
A1 B1 C1 D1
E2 F2

IEC 61482-1-2

EN ISO 14116
Index 3

Reference:	TP 0275 T
Colour:	Bright orange
Size:	SM to 3XL (ALL SIZES ARE MTO)



MTO = Made to order. *Tychem® ThermoPro TP275T Sleeved gown provides partial body protection (Cat. III PB[3]) and does not comply with the requirements of Type 4 and Type 6.

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Tychem® 6000 F

FACESEAL

Tight design combined with trusted Tychem® protection.

Tight design technologies: rubber seal around the mask offers good compatibility with full face mask and sealed in gloves for full body protection.

No need for taping, enables faster donning in emergency situations and industrial applications.

Rear entry with double flaps for enhanced safety of the wearer from frontal exposure.

Attached dissipative socks with boot flap.

Enables earthing of the wearer through dissipative boots without need for additional earthing cables.

Specially for emergency responder teams who may stock the garments for longer periods of time, the manufacturing date is featured on the box packaging.

Chemical spill clean-up

Emergency response

Industrial manufacturing and cleaning

Reference:	TF 0611 T GY UG
Colour:	Grey
Size:	SM to 5XL (SIZES SM, 4XL AND 5XL ARE MTO)

MTO = Made to order. * Does not protect against ionizing radiation.



Tight fitting hood



Double zipper flap



Double cuffs with attached undergloves on inner cuff







Category III

TYPE 3-B

TYPE 4-B

TYPE 5-B

TYPE 6-B

EN 1149-5

EN 1073-2* Class 1

EN 14126

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Tychem® 6000 F Plus

Tychem® 6000 F barrier in new innovative designs.

Smart design features: innovative hood which fits perfectly full face masks, double cuffs, double zippers & double flaps

Inside knitted cuffs for enhanced comfort

Lightweight, durable Tychem® 6000 F fabric (<500 g per garment)

The garment can be reused if it is not contaminated or damaged

Available with additional design options: with attached gloves, with dissipative socks, with attached gloves and dissipative socks



Tychem® 2000 Tape can be used for a tight connection between the coverall and other PPE



Double zipper system



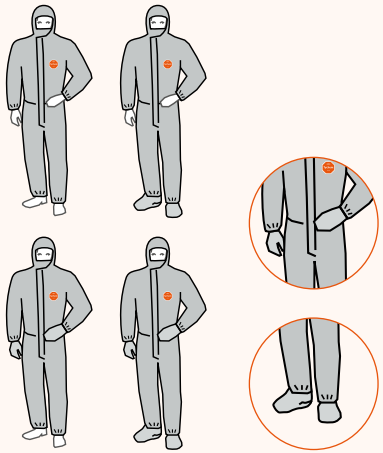
Double cuffs



Chemical spill clean-up

Emergency response

Petrochemical applications



Reference:	TF CHZ5T GY 00 (STANDARD)
Colour:	Grey
Size:**	SM to 3XL

* Does not protect against ionizing radiation. ** Sizes 4XL & 5XL available soon

Category III

TYPE 3-B

TYPE 4-B

TYPE 5-B

TYPE 6-B

EN 1149-5

EN 1073-2* Class 1

EN 14126

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Tychem® 6000 F Plus



Reference:	TF CHZ5T GY 08 (WITH ATTACHED GLOVES)*
Colour:	Grey
Size:**	SM to 3X



Reference:	TF CHZ5T GY 18 (WITH DISSIPATIVE SOCKS)*
Colour:	Grey
Size:**	SM to 3X



Reference:	TF CHZ5T GY 26 (WITH ATTACHED GLOVES AND DISSIPATIVE SOCKS)*
Colour:	Grey
Size:**	SM to 3X

* All sizes are made to order. ** Sizes 4XL & 5XL available soon.

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Tychem® 6000 F

WITH DISSIPATIVE SOCKS

Dissipative Socks smart solution that allows grounding of a wearer from inside through conductive shoes and floor without additional wiring.

Tested according to EN 61340-4-5:2014 with adapted test conditions of air temperature 22±1°C and relative humidity of 25±3% as per EN 1149-1 to evaluate earthing feasibility thru adequate footwear.

Earthing through dissipative footwear as alternative to earthing cord.

Hooded coverall with attached dissipative socks and boot flap. Stitched and over-taped seams. Thumb loops. Elasticated at the wrists, face and waist. Grey colour.

Chemical spill clean-up

Emergency response

Petrochemical applications

Reference:	TF CHA6 T GY 16 (WITH SOCKS)
Colour:	Grey
Size:	SM to 3XL (SIZE SM IS MTO)

MTO = Made to order. * Does not protect against ionizing radiation.



Self-adhesive chin and zipper flap



Thumb loops



Dissipative socks







Category III

TYPE 3-B

TYPE 4-B

TYPE 5-B

TYPE 6-B

EN 1149-5

EN 1073-2* Class 1

EN 14126

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Tychem® 6000 F

Trusted protection against a broad range of chemicals and biohazards.

Protection against numerous toxic industrial organic chemicals, highly concentrated inorganic chemicals and biohazards. Chemical permeation data available for more than 250 chemicals.

Protective seams, stitched and over-taped with barrier-tape, providing barrier performance equal to that of the fabric.

Double self-adhesive zipper flap offers high level of protection.

Option for grey model: Socks attached to the ankle: to be worn inside safety boots or shoes with additional knee-length boot flap to ensure a high protection level.

Chemical spill clean-up

Emergency response

Petrochemical applications

Reference:	TF CHA5 T GY 00 TF CHA5 T OR 00 TF CHA5 T GY 16 (WITH SOCKS)
Colour:	Grey or orange
Size:	SM to 5XL (SIZE SM, 3XL - 5XL ARE MTO)

MTO = Made to order. * Does not protect against ionizing radiation.



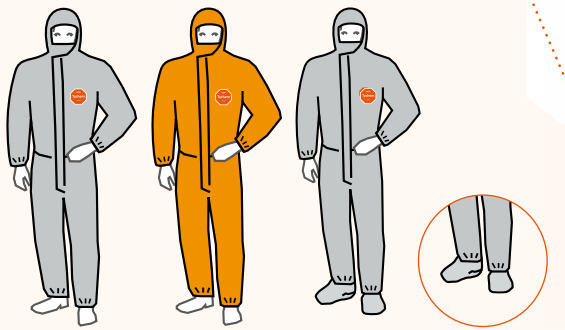
Self-adhesive chin and zipper flap



Thumb loops



Also available with socks





Category III

TYPE 3-B

TYPE 4-B

TYPE 5-B

TYPE 6-B

EN 1149-5

EN 1073-2*
Class 1

EN 14126

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Tychem® 6000 F

ACCESSORIES*

Tychem® 6000 F accessories can offer enhanced protection of body parts that are more exposed to hazardous substances.

CE Category & Type



Category III



TYPE PB[3]*



Tychem® 6000 F Gown 0290

Knitted cuff for better comfort.
Double cuffs for increased protection and tighter connection with gloves.
Mandarin collar for improved neck and throat area closure.

Reference:	TF 0290 T GY 00
Colour:	Grey
Size:**	SM/MD and LG/2XL



Tychem® 6000 F Apron

Shin-length apron with neck and waist ties.

Reference:	TF PA30 T GY 00
Colour:	Grey
Size:	One size



Tychem® 6000 F Sleeve

50 cm long and with wide elastics at cuffs and upper arm.

Reference:	TF PS32 T GY 00
Colour:	Grey
Size:	One size



Tychem® 6000 F Boot cover

Knee-length overboot with slip-retardant sole. Fixation ties.
Sole is partially stitched: splash-proof, not fully liquid tight.

Reference:	TF POBA S GY 00
Colour:	Grey
Size:	One size

* Partial body protection. ** Size 3XL/5XL available soon

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Tychem® 4000 S

A new comfortable alternative against a broad range of inorganic and organic chemicals.

Offers a barrier to permeation for more than 100 chemicals.

Double zip and double flaps permit limited re-use if not contaminated.

Double cuff system for good glove compatibility***.

A comfortable garment specifically designed for ease-of-wear.



Double zip closure

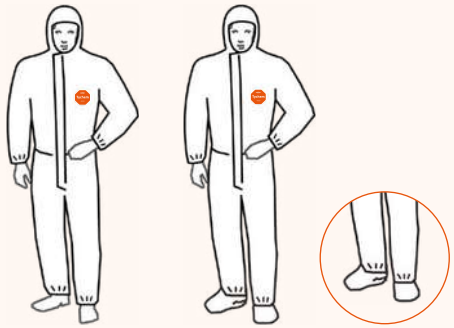


Double cuff system



Also available with socks





Oil and gas

Emergency response

Industry

Reference:	SL CHZ5 T WH 00 SL CHZ6 T WH 16 (WITH SOCKS)
Colour:	White
Size:	SM to 3XL

Category III

TYPE 3-B

TYPE 4-B

TYPE 5-B

TYPE 6-B

EN 1149-5*

EN 1073-2** Class 1

EN 14126

* Please see instructions for use for details. ** Does not protect against ionizing radiation.
*** Cuffs recommended to be taped to gloves for a tight seal.

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Tychem® 2000 C

Comfortable, lightweight protection against biohazards and numerous inorganic chemicals.

Protection against numerous concentrated inorganic chemicals and biohazards.

Protective seams, stitched and over-taped with barrier-tape, providing barrier performance equal to that of the fabric.

Double self-adhesive zipper flap offers high level of protection.

Option: Socks attached to the ankle, to be worn inside safety boots or shoes with additional knee-length boot flap to ensure a high protection level.

Food processing

Emergency response

Industry

Reference:	TC CHA5TYL 00 TC CHA5TYL 16 (WITH SOCKS)
Colour:	Yellow
Size:	SM to 3XL



Self-adhesive zip-per and chin flap



Thumb loops



Also available with socks









Category III

TYPE 3-B

TYPE 4-B

TYPE 5-B

TYPE 6-B

EN 1149-5

EN 1073-2*
Class 1

EN 14126

* Does not protect against ionizing radiation.

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Tychem® 2000 C

ACCESSORIES*

Tychem® 2000 C accessories can offer enhanced protection of body parts that are more exposed to hazardous substances.

CE Category & Type

Category III

TYPE PB[3]*



Tychem® 2000 C Gown 0290

Knitted cuff for better comfort. Double cuffs for increased protection and tighter connection with gloves. Mandarin collar for improved neck and throat area closure.

Reference:	TC 0290 T YL 00
Colour:	Yellow
Size:**	SM/MD and LG/2XL



Tychem® 2000 C Apron

Shin-length apron with neck and waist ties.

Reference:	TC PA30 T YL 00
Colour:	Yellow
Size:	One size



Tychem® 2000 C Sleeve

50 cm long and with wide elastics at cuffs and upper arm.

Reference:	TC PS32 T YL 00
Colour:	Yellow
Size:	One size



Tychem® 2000 C Boot cover

Knee-length overboot with slip-retardant sole. Fixation ties.
Sole is partially stitched: splash-proof, not fully liquid tight.

Reference:	TC POBA S YL 00
Colour:	Yellow
Size:	One size

* Partial body protection. ** Size 3XL-5XL available soon

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Tychem® 2000
ACCESSORIES*

Chemical protective tape to improve the safety level of your PPE.



DuPont™ Tychem® 2000 Tape

Chemical barrier tape with Tychem® 2000 level of protection and secure adhesion. Chemical protection against inorganic acids and bases.

Reference:	QC 0990 YL NL
Colour:	Yellow
Size:	One size

* Partial body protection.

CE Category

Category I certified according to Regulation (EU) 2016/425

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GARMENTS

DUPONT™

Tyvek®

Garments & Accessories



& ACCESSORIES

Back to summary

Tyvek® 800 J

The new, breathable Type 3 garment for protection against water-based inorganic chemicals under pressure.

An effective barrier against many low-concentration, water-based inorganic chemicals (even under pressure), small-sized hazardous particles as well as oil repellent.

Bright, over-taped seams aid wearer identification.

Soft and lightweight fabric that is permeable to both air and water vapour.

Ergonomic fit consistent with the shape and movement of the user.

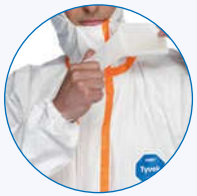
Liquid protection and/or oil repellency

Petrochemical installations

Maintenance operations

Reference:	TJ 0198 T WH 00
Colour:	White
Size:	SM to 7XL (SIZES 4XL TO 7XL ARE MTO)

MTO = Made to order. * Does not protect against ionizing radiation.



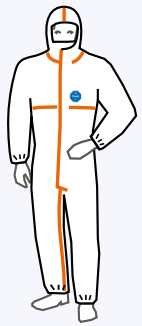
Self-adhesive chin flap



Elasticated waist



Thumb loops





Category III

TYPE 3-B

TYPE 4-B

TYPE 5-B

TYPE 6-B

EN 1149-5

EN 1073-2* Class 2

EN 14126

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Tyvek® 600 Plus

Combining Type 4 performance with the durability, protection and comfort of a Tyvek® garment.

Combines performance of a Type 4 with the comfort of a nonwoven suit.

Stitched and overtaped seams, offering equal barrier as fabric.

Hood shape and elastic around hood are designed for a tight fit around full face respirator.

Tunnelled elastics, cuff, ankles and face help to reduce the risk of contamination.

Nuclear industry

Medical applications

Biological hazards

Agriculture

Reference:	TY CHA5 T WH 00 TY CHA5 T WH 16 (WITH SOCKS) TY CHA5 T GR 16
Colour:	White or green
Size:	XS to 7XL (WHITE - SIZES XS AND 4XL TO 7XL ARE MTO) (WHITE WITH SOCKS - SIZES XS AND 4XL TO 7XL ARE MTO) (GREEN - SIZES XS, SM, MD & 3XL TO 7XL ARE MTO)



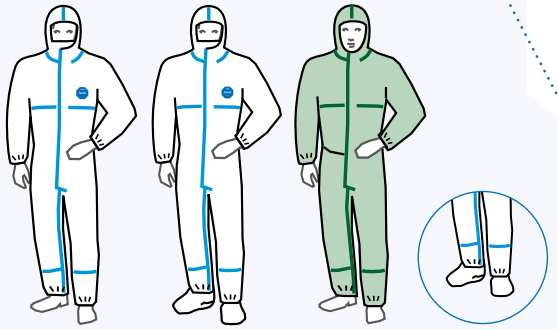
Elasticated waist



Thumb loops



Also available with socks





Category III

TYPE 4-B

TYPE 5-B

TYPE 6-B

EN 1149-5**

EN 1073-2* Class 2

EN 14126

MTO = Made to order. * Does not protect from ionizing radiation. ** Not applicable to green model.

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Tyvek® 500 Labo

Protecting wearers and processes in laboratories and clean environments.

Protects you and your processes in laboratories and the pharmaceutical industry.

Innovative “feel good effect” shape for greater comfort and flexibility.

Extremely high garment production quality control specifications.



3-piece hood



Slip-retardant soles



Attached overshoes



Category III

TYPE 5-B

TYPE 6-B

EN 1149-5*

EN 1073-2** Class 2

EN 14126

Pharmaceutical industry

Laboratories, cosmetics

Optical and electronics

Reference:	TY CHF7 S WH 00
Colour:	White
Size:	SM to 3XL

* Please see instructions for use for details. ** Does not protect from ionizing radiation.

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Tyvek® 500 Xpert

Setting a new standard of protection in the Type 5 and 6 category through greater protection and comfort.

ALSO AVAILABLE IN A SUSTAINABLE PACKAGING OPTION ECO PACK

High liquid and particulate protection.

Exceptional design and comfort.

Good breathability thanks to air and moisture vapour permeability.

Overall ergonomic shape for perfect fit and protection when moving.



Good hood fit



Long zipper puller



Ergonomic shape





Category III

TYPE 5-B

TYPE 6-B

EN 1149-5**

EN 1073-2* Class 2

EN 14126

Reference:	TY CHF5 S WH XP TY CHF5 S GR 00 TY CHF5 S BU 00
Colour:	White, green or blue
Size:	Sizes 4XL-7XL are MTO (WHITE - SM-7XL) (GREEN OR BLUE - SIZES SM AND 3XL ARE MTO)

Oil and gas · Maintenance operations · Paint spraying · Pharmaceutical industry · Chemical processing

MTO = Made to order. * Does not protect from ionizing radiation. ** Not applicable to green model.

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Tyvek® 500 HP

Solution for wearers needing chemical protection when working at heights.

Protection of your fall arrest equipment / lanyard worn underneath while protecting the wearer at the same time thanks to the back pass-thru system and the hook & loop closure at the end.

Protection of the worker thanks to the tight design through sealable chin flap & zipper flap, elasticated cuffs with thumb loops and snap closure system for the pass-thru.

Design validated by a long series of mannequin fall tests.

High level of comfort and mobility due to extremely light weight and the breathability of the Tyvek® fabric.

Superior chemical protection and durability thanks to the unique Tyvek® fabric.

Free of silicone, oil, grease, contaminates, foreign materials and surface irregularities (suitable for paint applications).

Cleaning at heights (facades, tanks, sewages)

Painting at heights (aircrafts, trains)

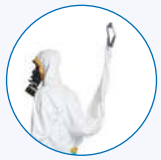
Maintenance at heights (asbestos removal, cleaning)

Reference:	TY 198 S WH HP
Colour:	White
Size:	SM to 3XL (ALL SIZES ARE MTO)

MTO = Made to order. * Does not protect from ionizing radiation.



2-piece hood for good fit around respirator



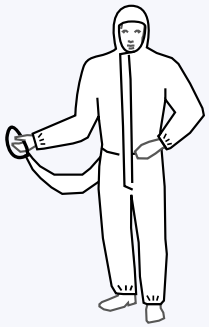
Pass-thru system



Snap closure for full tightness when pass-thru is not used



Hook and loop closure when connecting to the carabiner





Category III

TYPE 5-B

TYPE 6-B

EN 1149-5

EN 1073-2* Class 2

EN 14126

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Tyvek® 500 Industry

Protection for workers, and their products, in sensitive industrial environments.

Helps to protect processes and products against human contamination.

Tyvek® zipper and zipper flap for increased wearer and process protection.

Internal stitched seams for enhanced process protection.



Collar



Elasticated waist



Elasticated wrists and ankles



Category III

TYPE 5

TYPE 6

EN 1149-5

EN 1073-2* Class 1



Pharmaceutical industry

Biotech and electronic settings

Microbiological contamination control

Reference:	TY CCF5 S WH 00
Colour:	White
Size:	SM to 3XL

* Does not protect from ionizing radiation.

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Tyvek® 500 HV

High visibility that doesn't wash out!

High visibility that doesn't wash out: no laundry, no effect on colour, no need to monitor it.

All-in-one solution: high-visibility (to the highest class), chemical, biological and antistatic protections in one coverall.

Can replace your reusable high visibility clothing.

Durability & breathability of Tyvek®.

Ideal when working in dangerous environments, darkness or poor weather conditions.



Collar



Fluorescent orange for day visibility



Retro-reflective bands for night visibility





Category III

EN ISO 20471
RIS-3279-TOM-1*

TYPE 5-B

TYPE 6-B

EN 1149-5

EN 1073-2**
Class 1

EN 14126

Reference:	TY 0125 S HV
Colour:	Fluorescent Orange with silver grey retro-reflective bands
Size:	SM to 3XL

High visibility

Waste handling

Rail industry, undergrounds

Construction

* High Visibility Clothing. RIS-3279-TOM Issue 1 (replaces GO/RT 3279 Issue 8).
** Does not protect against ionizing radiation.

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Tyvek® 400 Dual

Protection and durability in the front breathability in the back.

Tyvek® protection where you need it most.

Large breathable SMS back panel from head to ankle for increased comfort.

External stitched seams for enhanced protection against penetration from the outside to the inside of the garment.



3 piece hood



SMS back panel



Elasticated waist



Category III

TYPE 5

TYPE 6

EN 1149-5

EN 1073-2* Class 1

Frontal exposure during firing, foundries and smelting operations

Paint spraying

Work involving composite materials



Reference:	TD CHF5 S WH 00
Colour:	White
Size:	SM to 3XL

* Does not protect from ionizing radiation.

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Tyvek® 400 DualFinish

Front that reduces the risk to stick or delaminate when exposed to tacky resins, comfort in the back.

Developed with end users to answer their needs for superior frontal protection while sustaining ventilation and protection in the back.

Frontal protection serves as an excellent barrier to tacky resins, fibres and many other hazards.

Large breathable SMS back panel from shoulders to ankles ensures good protection and ventilation from heat.

External stitched seams for enhanced protection against penetration from the outside to the inside of the garment.



Hood



SMS back panel



Thumb-loop





Category III

TYPE 5

TYPE 6

EN 1149-5

Paint spraying

Work involving composite materials

Reference:	TD 0127S WH 00
Colour:	White
Size:	SM to 4XL

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Tyvek® 400 DualCombi

For environments where comfort is important and exposure risk limited to front.

Developed with end users to answer their needs for superior frontal protection while sustaining high ventilation and breathability in the back.

Frontal protection serves as an excellent barrier to tacky resins, fibres and many other hazards.

Breathable back panel from shoulders to ankles ensures ventilation and protects from excessive body heat.



Collar



Polyprop back panel



Thumb-loop



Category III

TYPE PB[6]*

Paint spraying

Work involving composite materials



Reference:	TD 0125 S WH 00
Colour:	White
Size:	SM to 4XL

* Partial Body Protection.

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Tyvek® 200 EasySafe

Great breathability and optimised protection for less demanding applications.

Based on a new optimised polyethylene nonwoven fabric.

Soft touch fabric for wearer comfort.

Optimised design and packaging.



Good hood fit



Yellow stitched seams



Elasticated waist



Category III

TYPE 5

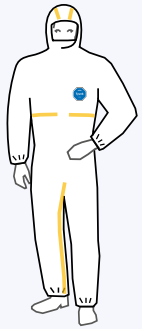
TYPE 6

EN 1149-5

EN 1073-2* Class 1

Remediation

Industrial cleaning and general manufacturing



Reference:	TS CHF5 S WH DE
Colour:	White
Size:	SM to 3XL

* Does not protect against ionizing radiation.

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Tyvek® 500
ACCESSORIES*

Specially designed for use with Tyvek® apparel, Tyvek® 500 accessories can help offer enhanced protection for body parts that are more exposed to hazardous substances, or protect processes from contamination.

CE Category & Type



Category III



TYPE PB [6-B]*



Tyvek® 500 Labcoat with press studs and pockets

Labcoat with collar, available in white and in sizes MD to 2XL. 5 press stud closures. 3 pockets. Stitched internal seams.

Reference:	TY PL30 S WH 00
Colour:	White
Size:	MD to 2XL



Tyvek® 500 Labcoat with press studs and without pocket

Labcoat with collar, available in white and in sizes MD to 2XL. 5 press stud closures. Without pockets. Elasticated cuffs (not tunnelled). Stitched internal seams.

Reference:	TY PL30 S WH NP
Colour:	White
Size:	MD to 2XL



Tyvek® 500 Labcoat with zipper and pockets

Labcoat with collar, available in white and in sizes SM to 2XL. Zipper closure. 2 pockets. Elasticated cuffs (tunnelled). Stitched internal seams.

Reference:	TY PL30 S WH 09
Colour:	White
Size:	SM to 2XL



Tyvek® 500 Labcoat with zipper and without pocket

Labcoat with collar, available in white and in sizes SM to 2XL. Zipper closure. Without pocket. Elasticated cuffs (tunnelled). Stitched internal seams.

Reference:	TY PL39 S WH NP
Colour:	White
Size:	SM to 2XL

All Tyvek® 500 accessories are supplied with an antistatic treatment. * Partial body protection.

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Tyvek® 500

ACCESSORIES*

Specially designed for use with Tyvek® apparel, Tyvek® 500 accessories can help offer enhanced protection for body parts that are more exposed to hazardous substances, or protect processes from contamination.

CE Category & Type

Category III

TYPE PB [6-B]*



Tyvek® 500 Apron

Shin-length apron with neck and waist ties. Available in white and in one size (length 108 cm).

Reference:	TY PA30 S WH L0
Colour:	White
Size:	One size



Tyvek® 500 Jacket

Hooded jacket available in white and in sizes MD to 2XL. Zipper closure. Stitched internal seams.

Reference:	TY PP33 S WH 00
Colour:	White
Size:	MD to 2XL



Tyvek® 500 Trousers

Trousers available in white and in sizes MD to 2XL. Without pockets. Elasticated waist, no elastic at ankles. Stitched internal seams.

Reference:	TY PT31 S WH L0
Colour:	White
Size:	MD to 2XL



Tyvek® 500 Hood

Hood with flange and elasticated face and neck. Available in white and in one size.

Reference:	TY PH30 S WH L0
Colour:	White
Size:	One size

All Tyvek® 500 accessories are supplied with an antistatic treatment. * Partial body protection.

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Tyvek® 500
ACCESSORIES*

CE Category & Type

Category III

TYPE PB [6-B]*



Tyvek® 500 Sleeve

50 cm long sleeve available in white and in one size. Adjustable arm opening. Stitched internal seams. Upper-arm in blue-coloured thread for identification purposes.

Reference:	TY PS32 S WH LA
Colour:	White
Size:	One size



Tyvek® 500 Boot cover

Knee-length overboot available in white and in one size. Elasticated top and fixation ties. Stitched internal seams.

Reference:	TY POB0 S WH 00
Colour:	White
Size:	One size



Tyvek® 500 Boot cover with antislip

Knee-length overboot available in white and in one size. Elasticated top and fixation ties. Stitched internal seams. Slip-retardant sole.

Reference:	TY POBA S WH 00
Colour:	White
Size:	One size



Tyvek® 500 Shoe cover

Shoe cover available in white and in one size (38 cm long). Elasticated ankle. Stitched internal seams.

Reference:	TY POS0 S WH 00
Colour:	White
Size:	One size

All Tyvek® 500 accessories are supplied with an antistatic treatment. * Partial body protection.

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Tyvek® 500
ACCESSORIES*



Tyvek® 500 Shoe cover with antislip

Shoe cover available in white and in sizes 36 to 42 and 42 to 46. Elasticated ankle. Stitched internal seams. Slip-retardant sole.

Reference:	TY POSA S WH 00
Colour:	White
Size:	36 to 42 & 42 to 46

All Tyvek® 500 accessories are supplied with an antistatic treatment. * Partial body protection.

CE Category & Type

Category III

TYPE PB [6-B]*

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GARMENTS

DUPONT™

Tyvek® IsoClean®

Garments & Accessories



& ACCESSORIES

Back to summary

Controlled environments apparel selection guide

When it comes to working in a broad range of controlled environments, specifiers have many product options from which to select. The process to understand which option matches a given environment can be confusing. DuPont has tried to help reduce some of that burden by providing a complete line of products and information to help guide specifiers through their selection process. To get the most out of your cleanroom apparel, it is necessary to understand where each product can be used. To provide a quicker overview of our products and where they are intended for use, we developed the simple guide. Our goal is to provide the appropriate DuPont product that is suitable for a given environment or hazard.

FABRIC PERFORMANCE FEATURES

Fabric	Tyvek® IsoClean®, clean-processed and sterile	Tyvek® IsoClean®, sterile	Tyvek® IsoClean®, non-sterile
Available Sterile	Yes, Option code CS, MS and DS	Yes, Sterile Option code 0S and TS	No, Option codes 00 and 0B
Particle Barrier	●	●	●
Non-Hazardous Liquid Barrier	◐	◐	◐
Comfort	◐	◐	◐
Durability	●	●	●
Static Dissipation*		●	●
Particle Shedding and Cleanliness	●	◐	◐
Strengths	Ideal combination of protection, durability, comfort and cleanliness.	Ideal combination of protection, durability, comfort and cleanliness.	Ideal combination of protection, durability, comfort and cleanliness.

Comparison within the DuPont portfolio: ● Best ◐ Good (Blank) Not recommended

* Electrostatic discharges.
Antistatic performance may be reduced for sterile products.
Barrier properties may be compromised through use.

Controlled environments apparel selection guide

Comparison within the DuPont portfolio: ● Best ◐ Good (Blank) Not recommended

	Environments/Hazards	Tyvek® IsoClean®			Considerations
		Clean-Processed and Sterile (Option codes CS, MS and DS)	Sterile (Option codes 0S and TS)	Non-Sterile (Option codes 00 and 0B)	
Environments	GMP A&B, ISO 4/5, controlled environments*	●	◐		Tyvek® IsoClean® sterile garments offer excellent cleanliness, barrier and sterility assurance level.
Environments	GMP C&D, ISO 6/9, controlled environments*			●	Tyvek® provides an inherent particle barrier and durability, and is low linting. Clean-processing and bound seams should be considered for more critical environments.
Hazards	Non-hazardous, dry particles	●	●	●	Tyvek® provides an inherent barrier against small particles. Bound seam garments offer a higher level of protection than serged seam garments.
Hazards	Hazardous powders Notice: DuPont Controlled Environments garments should not be used in potentially explosive or flammable environments.	●	●	●	Use bound seamed garments when working with hazardous powders.
Hazards	Hazardous liquid splash Examples: organic solvents, caustics				Please refer to our Tychem® product line for liquid and vapor chemical protection.

* Tyvek® IsoClean® (Option Code CS, DS and MS) garments are most typically considered for use in GMP A-D, ISO Class 5-8. However, use in ISO Class 4 and 9 environments may also be considered depending on the needs of a particular application. In all cases, garment choice depends on evaluation of, among other attributes, garment design and processing, as well as the needs of specific applications. Clean-processed and bound seam garments offer the highest level of contamination control and should be used in more critical applications. Sterile garments are available if required. It is the end-user's responsibility to determine the appropriate garment for a given application.

Tyvek® IsoClean®

New!

CLEAN-PROCESSED AND STERILE COVERALL IC 193 B

Coverall with attached hood and overboots

Sterility Assurance Level (SAL) of 10^{-6} (ISO 11137).

Helmke Drum Cat. 1 (IEST-RP-CC003.3).

Dual barrier validated packaging system (option DS) for contamination control and sterility risk management.

Packed in an ISO Class 4 Certified Cleanroom.

Internal bound seams covered with garment fabric to reinforce seam protection and reduce potential for liquid and particle penetration.

The hood fits a medical mask and has attached ties.

Biotechnology

Pharmaceutical

Medical device manufacturing

Reference:	IC 193 B WH DS
Colour:	White
Size:	XS to 7XL



Integrated hood with ties



Zipper closure with storm flap



Integrated overboots with Gripper™ sole



Option DS

Category III

TYPE 5-B

TYPE 6-B

EN 1073-2* Class 2

EN 14126

ISO 11137

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Tyvek® IsoClean®

CLEAN-PROCESSED AND STERILE COVERALL IC 183 B

Unhooded coverall

Sterility Assurance Level (SAL) of 10^{-6} (ISO 11137).

Helmke Drum Cat. 1 (IEST-RP-CC003.3).

Dual barrier validated packaging system (option DS) for contamination control and sterility risk management.

Packed in an ISO Class 4 Certified Cleanroom.

Internal bound seams covered with garment fabric to reinforce seam protection and reduce potential for liquid and particle penetration.

Clean-processed and sterile

Medical device manufacturing

Pharmaceutical production

Reference:	IC 183 B WH DS
Colour:	White
Size:	SM to 3XL



Bound neck



Waist elastication



Tyvek® covered thumb loops



Option DS

Category III

TYPE 5-B

TYPE 6-B

EN 1073-2* Class 2

EN 14126

ISO 11137

* Does not protect from ionizing radiation.

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Tyvek® IsoClean®

CLEAN-PROCESSED AND STERILE COVERALL IC 105 S

Hooded coverall

Sterility Assurance Level (SAL) of 10^{-6} (ISO 11137).

Helmke Drum Cat. 1 (IEST-RP-CC003.3).

Hooded coverall with attached slip-retardant shoe covers.

Clean-processed and gamma-sterilized.

Serged internal seams.

Not CE Certified.

Clean-processed and sterile

Medical device manufacturing

Pharmaceutical production

Reference:	IC 105 S WH CS
Colour:	White
Size:	MD to 3XL

* Does not protect from ionizing radiation.



Hood



Elastication at wrists, ankles and face.



Thumb loops



Option CS

ISO 11137

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Tyvek® IsoClean®

CLEAN-PROCESSED AND STERILE ACCESSORIES*

Type

T6

TYPE PB[6]*

Category I



Tyvek® IsoClean® Labcoat with bound neck - model IC 270 B option MS

Labcoat available in white in sizes SM to 3XL. Bound seams. Covered elastication at wrists. Front snap closure for easy donning and doffing. Packed in a dual barrier validated packaging system (double bagged).

Reference:	IC 270 B WH MS
Colour:	White
Size:	SM to 3XL

CE Category III



Tyvek® IsoClean® Sleeve - model IC 501 B option MS

Sleeve available in white and in one size. Bound seams. Tunnelled elastication at wrist and bicep. Packed in a dual barrier validated packaging system (double bagged).

Reference:	IC 501 B WH MS
Colour:	White
Size:	One size

CE Category III



Tyvek® IsoClean® Boot cover - model IC 458 B option MS

Boot cover available in white, in sizes SM to XL. Bound seams. Covered elasticated leg opening. Ankle ties. Slip-retardant Gripper™ sole. 18" (45.7 cm) high. Packed in a dual barrier validated packaging system (double bagged).

SM: 10" fits up to UK men's size 4.5/EU 37; MD: 12" fits up to UK men's size 6 1/2/EU 39.5; LG: 14" fits up to UK men's size 131/2/EU 48.5; XL: 16" Fits up to UK men's size 18 1/2/EU 53

Reference:	IC 458 B WH MS
Colour:	White
Size:	SM to XL

CE Category III



Tyvek® IsoClean® Hood with ties - model IC 668 B option MS

Hood available in white and in one size. Bound seams. Bound hood opening. Full face opening. Ties with loops for adjustable fit. Packed in a dual barrier validated packaging system (double bagged).

Reference:	IC 668 B WH MS
Colour:	White
Size:	One size

N/A = Not Applicable. *Partial body protection.

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Tyvek® IsoClean®

CLEAN-PROCESSED AND STERILE ACCESSORIES*

CE Category I



Tyvek® IsoClean® Hood and mask - model IC 982 B option MS

HOOD: Bound internal seams. Bound head opening. Ties with loops for adjustable fit. MASK: Pleated polyethylene outer. 17.5 cm wide. Sterile. Blue. Items packed in a dual barrier validated packaging system (double bagged).

Reference:	IC 982 B WH MS
Colour:	White
Size:	One size

CE Category I



Tyvek® IsoClean® Bouffant - model IC 729 WH option MS

Bouffant available in white and in one size. Elastic headband. Packed in a dual barrier validated packaging system (double bagged).

Reference:	IC 729 S WH MS
Colour:	White
Size:	One size

N/A = Not Applicable.



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Tyvek® IsoClean®

STERILE

New sterile only range coming up in 2022!

New!

Tyvek® IsoClean® Hood with attached mask and ties IC 689 B TS

Hood with attached mask* and ties for adjustable fit in the chest area. Available in white and in one size. Gamma-sterilized and double bagged. Bound internal seams. Bound face opening for low particle shedding. Aseptically folded.



Reference:	IC 689 B WH TS
Colour:	White
Size:	One size

* The attached mask is a blue sterile cleanroom mask made out of pleated polyethylene outer layer having a width of 17.5 cm. Please note that it is not a PPE (e.g. not an FFP1,2 or 3) mask.

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Tyvek® IsoClean®

NON-STERILE ACCESSORIES*

Type

T6

TYPE PB[6]*

CE Category III



Tyvek® IsoClean® Labcoat with bound neck - model IC 270 B option 0B

Labcoat available in white in sizes SM to 3XL. Bound seams. Covered elastication at wrists. Front snap closure for easy donning and doffing. White.

Reference:	IC 270 B WH 0B
Colour:	White
Size:	SM to 3XL

CE Category III



Tyvek® IsoClean® Gown - model IC 702 S option 00

Gown available in white and in sizes SM/MD and LG/2XL. Serged seams. Bound neck with ties. Knitted cuffs.

Bound ties originating at center front waist.

Reference:	IC 702 S WH 00
Colour:	White
Size:	SM/MD and LG/2XL

CE Category III



Tyvek® IsoClean® Sleeve - model IC 501 B option 00

Sleeve available in white and in one size. Bound seams. Covered elastic at both ends. 45 cm long.

Reference:	IC 501 B WH 00
Colour:	White
Size:	One size

CE Category III



Tyvek® IsoClean Shoe cover - model IC 451 S WH option 00

Shoe cover available in white and in sizes MD and LG. Fixation ties. Gripper™ sole. Stitched seams. MD: 11.75″ fits up to UK men's size 6 1/2/EU 39.5; LG: 14″ fits up to UK men's size 12 1/2/EU 47

Reference:	IC 451 S WH 00
Colour:	White
Size:	MD and LG

N/A = Not Applicable. *Partial body protection

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Tyvek® IsoClean®

NON-STERILE ACCESSORIES*

Type



TYPE PB[6]*

CE Category III



Tyvek® IsoClean Boot cover - model IC 458 B WH option 00

Boot cover available in white and in sizes MD and LG. Fixation ties. Gripper™ sole. Bound seams. MD: 12″ fits up to UK men's size 6 1/2/EU 39.5; LG: 14″ fits up to UK men's size 131/2/EU 48.5

Reference:	IC 458 B WH 00
Colour:	White
Size:	MD and LG

CE Category III



Tyvek® IsoClean® Chemo gown model IC 703 S option 00

Collared gown with hook and loop closure in the neck. Increased skirt length ensures protection against frontal exposure. Openness in the back closure increases wearer comfort. Serged seams. Knit cuffs. Bound ties at waist originating from elasticated sides.

Reference:	IC 703 S WH 00
Colour:	White
Size:	XS – 3XL FOR A BETTER FIT

CE Category III



Tyvek® IsoClean® Hood with ties - model IC 668 B option 00

Hood available in white and in one size. Bound seams. Bound hood opening. Full face opening. Ties with loops for adjustable fit.

Reference:	IC 668 B WH 00
Colour:	White
Size:	One size

CE Category III



Tyvek® IsoClean® Bouffant - model IC 729 S option 00

Bouffant available in white and in one size. Serged seams. Elastic headband. 54 cm diameter.

Reference:	IC 729 S WH 00
Colour:	White
Size:	One size

N/A = Not Applicable. * Partial body protection.

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GARMENTS

ProShield®

Garments



Back to summary

ProShield® 60

Best in class microporous film at a highly economical price.

New pattern for a better fit.

Good liquid repellency.

Protection against low-medium concentrated water-based chemicals.

Low air permeation versus Tyvek®.







Elasticated hood, waist, wrists and ankles

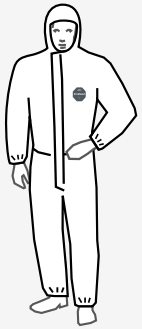


Storm flap



3-piece crotch area





Category III

TYPE 5

TYPE 6

EN 1149-5

EN 1073-2* Class 1

General maintenance

Industry

Reference:	P6 127 S WH 00
Colour:	White
Size:	SM to 7XL (4XL TO 7XL ARE MTO)

MTO = Made To Order * Does not protect from ionizing radiation.

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ProShield® 20 SFR

The solution to protect you and your flame-resistant workwear underneath.

Maximising wearer comfort: thanks to the open structure of its breathable non-woven SMS fabric.

Non-halogenated flame-retardant non-woven fabric, free of substances of very high concern to be compliant with REACH regulations.

Antistatic treatment on both sides***.



3 piece hood



Elasticated wrists



Elasticated waist



Category III

TYPE 5

TYPE 6

EN 1149-5

EN 1073-2* Class 1

EN ISO 14116** Index 1

Petrochemical industries

Metal grinding, gas and metal applications

Railway



Reference:	F1 CHF5 S WH 00
Colour:	White with orange seams***
Size:	MD to 3XL

* Does not protect from ionizing radiation.
** EN ISO 14116:2008 requires a tensile strength of >150 N. This garment has a tensile strength of >30 N only.
*** Test conducted on certain FR fabrics and FR garments have demonstrated that antistatic properties reduce overtime. In the interests of safety, that's why we initially limit the shelf-life for the antistatic property of ProShield® 20 SFR to 18 months.

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ProShield® 20

Based on an optimised SMS technology, ProShield® 20 is a breathable lightweight coverall for entry-level Type 5, 6 protection.

Limited particle protection.

High comfort level: high air and water vapour permeability.

Available in blue and white.



Elasticated hood



Elasticated wrists



Elasticated waist



Category III

TYPE 5

TYPE 6

EN 1149-5

EN 1073-2* Class 1

General maintenance

Industry



Reference:	PB CHF5 S WH 00 PB CHF5 S BU 00
Colour:	White or blue
Size:	SM to 3XL

MTO = Made To Order * Does not protect from ionizing radiation.

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ProShield® 8 Proper

Durable, washable and comfortable garment ideal for general maintenance activities.

A versatile ultra-tough protective garment with pockets for non hazardous substances.

Stiff, durable and dark coloured non-woven polyethylene fabric. Antistatic treated on the inside (for comfort).

Washable up to 7 times.



Mandarin collar



Elasticated waist



Open ankles (not elasticated)







Do-it-yourself



General maintenance



Cleaning



Re-usable garment for visitors

Reference:	TY CCF5 S GY 00
Colour:	Grey
Size:	SM to 2XL

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PROTECTION

DUPONT™

Kevlar®

GLOVES MADE WITH KEVLAR®
give you superior protection
and maximum comfort

COMFORT



Back to summary

What is Kevlar®?

Stephanie Kwolek developed the first liquid crystal polymer which provided the basis for DuPont™ Kevlar® brand fiber, an organic fiber in the aromatic polyamide family. Kevlar® has a unique combination of high strength, high modulus, toughness and thermal stability.

A legendary product

Since its creation, Kevlar® has found its way into the history books and pop culture. The iconic material has saved lives and continues to help humankind achieve what was once thought impossible.

1964

Kevlar® developed

1969

Apollo II, Kevlar® lands on the moon

1975

PASGT vest and helmet, Kevlar® protects American troops

1987

Ferrari F40, Kevlar® burns rubber in style

2006

New Horizons Space Probe, Kevlar® flies past Pluto

2013

Nike Elite II Series, Kevlar® hits the blacktop, Lebron wins his first championship

2014

Google TransPacific Fiber Cable, Kevlar® protects the internet

Legendary protection

5+ million

soldiers and police officers are protected by body armor made with Kevlar® every year

1+ billion

pairs of gloves and sleeves contain Kevlar®

Kevlar® fiber has built-in heat and flame resistance

THE VALUE OF MULTI-HAZARD PROTECTION

Only Kevlar® fiber is designed to protect workers against multiple hazards they encounter on the job — for increased safety and peace of mind.

CUT

PUNCTURE

ABRASION

ELECTRIC

FLAME

HIGH HEAT

GRIP

WELDING

Their safety is our job

Every glove and sleeve made with Kevlar® is more than just a promise of protection.

MULTI-HAZARD PROTECTION

Industry-leading cut performance with built-in heat, flame and arc flash resistance.

COMFORT

Lightweight, highly breathable and less rigid- giving users the comfort they want.

PARTNERSHIP

We work with our partners to provide the right level of protection for the task at hand.

PEACE OF MIND

Lab-tested performance and a cross-functional team dedicated to supporting you.

The right protection can make all the difference*

70% of hand injuries result from not wearing any type of hand protection

30% of hand injuries are caused by wearing the wrong glove

20% of disabling workplace injuries involve hands

* NSC.org, 2013 Safety Statistics for the Well Service Industry

What makes up hand protection

Keep protection and comfort intertwined

Patented Kevlar® engineered yarns are lightweight, highly breathable and less rigid—providing market-leading comfort and dexterity for the most intricate work.

LIGHTWEIGHT

HIGHLY BREATHABLE

FLEXIBILITY

DEXTERITY

The level of cut protection, reached by a glove, depends on many variables: material used in the liner, yarn construction and components and coating.

The Power of Kevlar®



Fiber type

Yarn construction

- Flat yarn
- Staple based spun yarn
- Textured yarn

Engineered yarns

- Fiber blends
- Reinforced with glass, steel

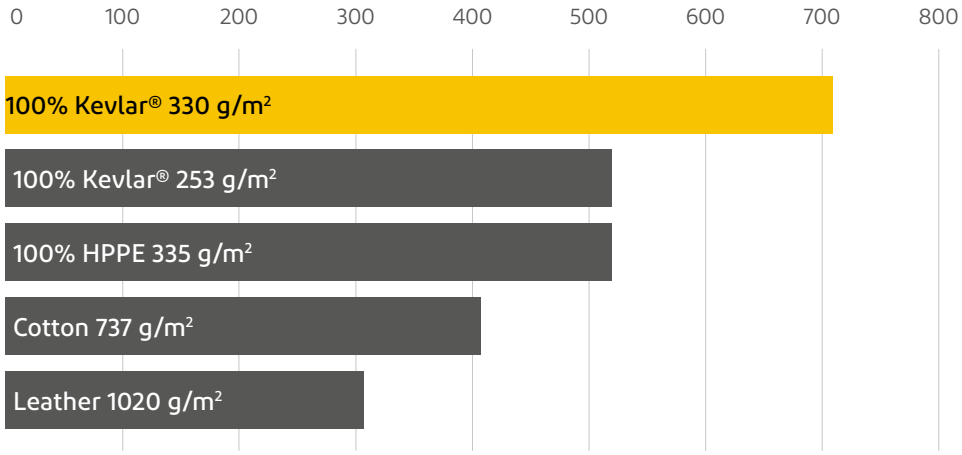
Suitable to all commonly used coatings

Protection that's a cut above

Kevlar® provides at least 30% higher cut resistance on an equal weight basis. Kevlar® can also be 25% lighter while providing the same level of cut resistance as competitors, for enhanced user comfort.

Kevlar® engineered yarn with steel has superior cut performance compared to competitors' engineered yarns.

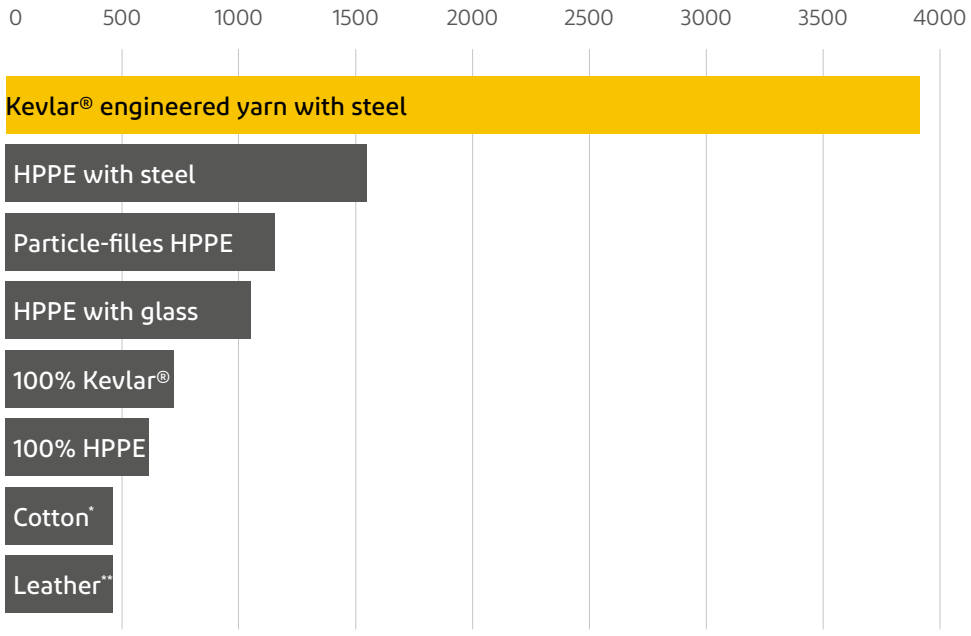
Grams of Force



Test method: ASTM 2992

* Cotton 737 g/m² ** Leather 1020 g/m²

Grams of Force



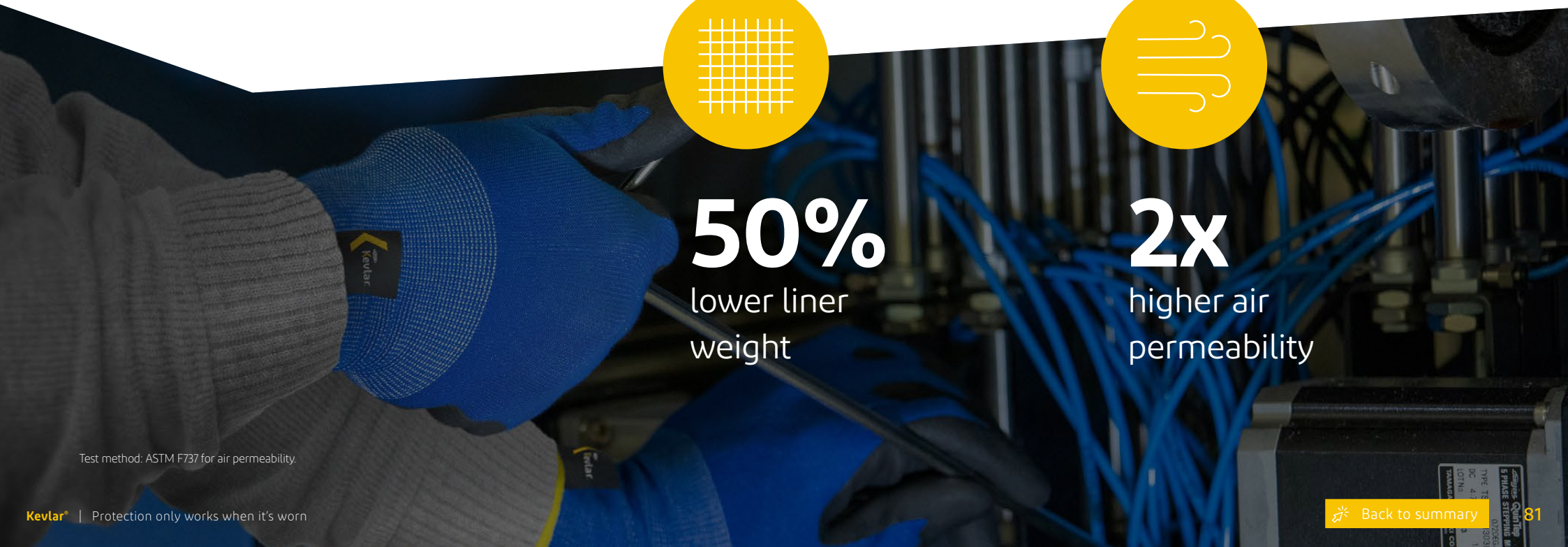
Test method: ASTM 2992. All knit glove liners. normalized to 295 g/m², unless noted

Protection only works when it's worn

With 70% of workplace injuries resulting from workers not wearing gloves, new Kevlar® engineered yarns offer increased comfort without sacrificing protection—so workers won't want to take them off.

Lower areal density correlates with lower weight and higher comfort

Lightweight, highly breathable and less rigid- giving users the comfort they want.



50%
lower liner weight

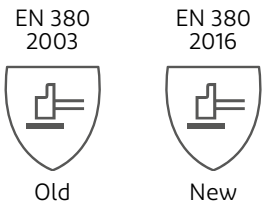
2x
higher air permeability

Test method: ASTM F737 for air permeability.

New standards. Consistent protection.

Only Kevlar® kept or increased its protection with the updated EN 388—2016 Standard.

	5	Old	
Kevlar® Engineered Yarn	E	New	
	5	Old	
HPPE Engineered Yarn	C	New	
	2	Old	
Leather	A	New	
	2	Old	
Cotton	A	New	



Kevlar® can also take the heat

100% Kevlar® is inherently flame resistant and doesn't ignite, melt or degrade in heat.

HPPE (UHWPE) starts to decompose above 400°C.

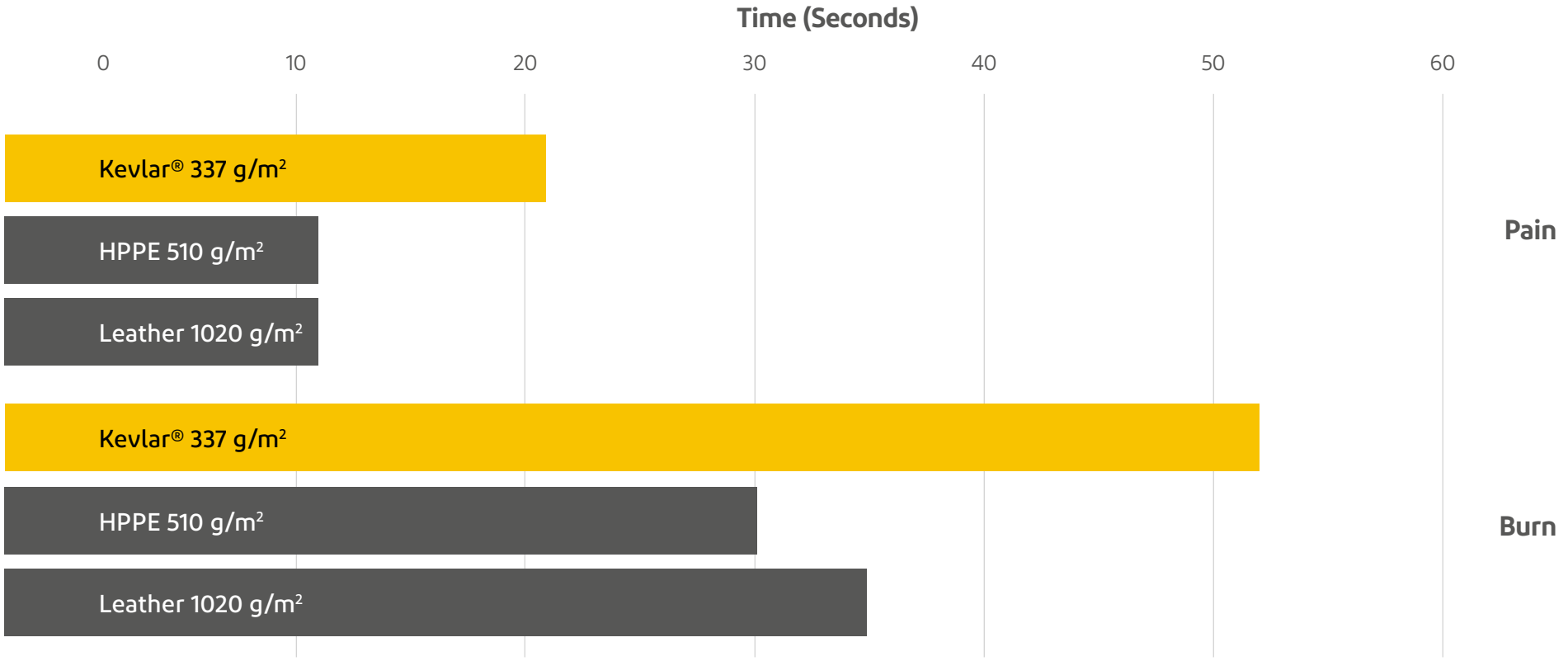
HPPE is not recommended for prolonged use above 70°C and has a melting point of 130°C.

	Melt Point	Decomposition
100% Kevlar®	-	800-900°F (472-482°C)
100% Nomex®	-	700-800°F (371-427°C)
Polyamide 6.6 (PA6.6)	480-500°F (249-260°C)	-
Polyester	470-490°F (243-254°C)	-
Polyamide (PA6)	420-430°F (216-221°C)	-
Rayon	-	325°F (163°C)
HPPE (UHWPE)	280-300°F (138-149°C)	-

Because every second counts

Kevlar® provides a 70% longer time to pain and burn vs. HPPE at a 50% lighter weight.

100° C Contact Temperature



Test method: ASTM F1060

Multiple hazards. One solution.

Kevlar® delivers industry-leading multi-hazard protection and meets the standards for:

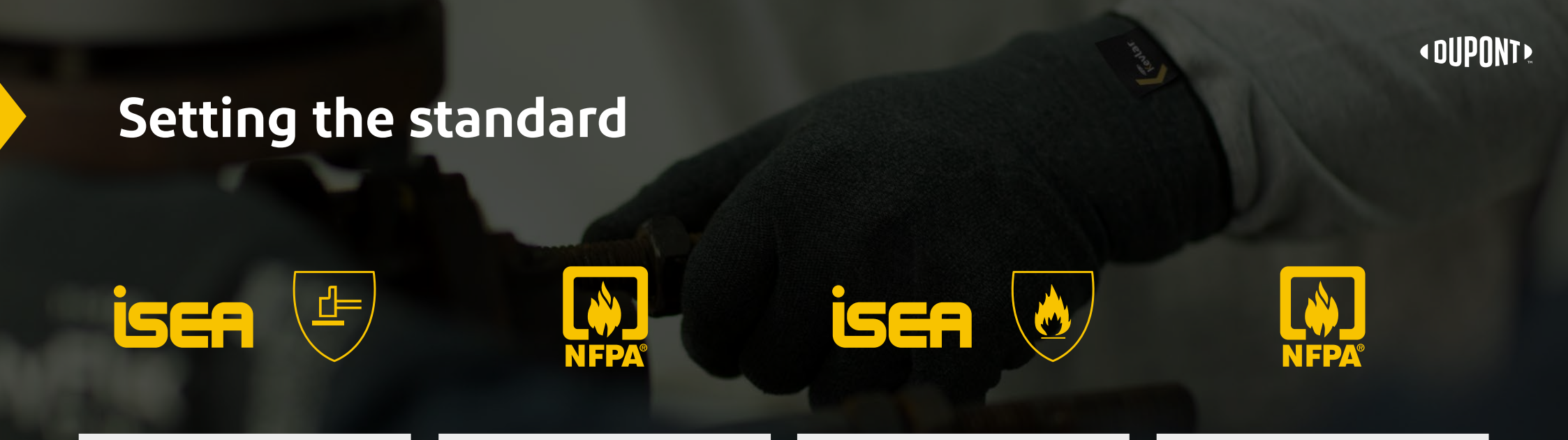
EN 407

EN 380

ISEA 105

ISO 23888

Setting the standard



ISEA 105/EN388

Solutions engineered with Kevlar® are designed to meet a range of requirements from low cut to the highest cut level requirements—providing a full spectrum of offerings that satisfy the latest ANSI 105:2016(A2-A9) and EN388:2016 (B-F) standards.

NFPA 2112

100% Kevlar® offerings enable compliance with the recently updated 2018 version of NFPA 2112, which now requires gloves to comply with the flame resistant standard. This includes compliance with no melt/no drip and heat transfer/resistance/ shrinkage requirements.

ISEA 105/EN407

100% Kevlar® has unique product performance capabilities. It resists thermal degradation and doesn't ignite, melt or drip. It passes the highest levels of contact heat before receiving pain or 2nd degree burns. 100% Kevlar® only decomposes at >800° F (427° C).

NFPA 70E

Kevlar® can be used as a component and enabler to meet arc flash standard requirements due to its inherent flame and heat resistant properties.

Kevlar® provides long-lasting value

Gloves made with Kevlar® retain their cut performance after laundering, which means fewer replacements without losing performance.

GLOVES OF 100% KEVLAR® CAN LAST UP TO

10 CLEANING CYCLES

Make innovation our common thread

Kevlar® engineered yarns continue to allow our partners to redefine what's possible when it comes to protection. Every year, the latest advancements are presented with the DuPont™ Kevlar® Innovation Award.

DuPont™ Kevlar® INNOVATION AWARD

The possibilities are endless

From the oil field to the battlefield, our partners continue to take protection to new heights with Kevlar® engineered yarns. In the last 5 years alone, 35 Innovation Award winners have been introduced —pushing the boundaries of cut and heat protection and arc flash and puncture resistance.



PROTECTION

DUPONT™

Nomex®

Garments made with Nomex® for heat, flame and arc protection



HEAT FLAME ARC

Back to summary

What is Nomex®?

DuPont™ Nomex® is a heat- and flame-resistant meta-aramid fiber used across a diverse range of applications – perhaps most commonly known as a key component in fabrics utilised to create **protective apparel**. Due to its unique combination of heat, flame and electric arc protection, durability and comfort, the Nomex® brand is trusted amongst those working in dangerous conditions such as firefighters; military pilots and combat vehicle crew; auto racing drivers, pit crew and track officials; and industrial workers at risk from **flash fire** and **electric arc hazards**.

Inherently flame resistant, Nomex® offers supreme strength and heat performance versus many other products on the market. It doesn't melt, drip or support combustion in the air. 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. As the protection is engineered into the molecular structure of the Nomex® fiber (as opposed to chemical treatment), the heat and flame resistance will last the lifetime of the garment – the protection cannot be washed out or worn away.



DuPont™ Nomex®: key benefits for protective apparel

NOMEX®

A synthetic fiber for coverall, gloves, suits & more

Nomex® PPE garments are created using Nomex®-based fabric, stitched together with Nomex® thread, providing optimal protection for the wearer against multiple hazards. This includes items such as: coveralls, protective gloves, suits (multi-layer jackets and trousers), balaclavas, hoods, trousers, tops and underwear (non-melting).

- Inherently flame resistant, does not melt or drip
- Contains no chemical treatment, halogens or heavy metal
- High thermal protective barrier
- High mechanical strength
- Lightweight comfort
- Dry feeling
- Permanent antistatic properties
- Better professional appearance over its lifetime after washing
- Backed by accredited testing laboratory
- Quality assurance with selected partners throughout value chain

Trusted Protection

DuPont™ Nomex® offers a level of protection that meets or exceeds the norms differentiating it from its competitors. Instead of being treated with a flame-retardant substance, Nomex® is inherently flame-resistant due to its specific molecular structure. Its thermal protection performance cannot be affected by washing, abrasion or exposure to heat.

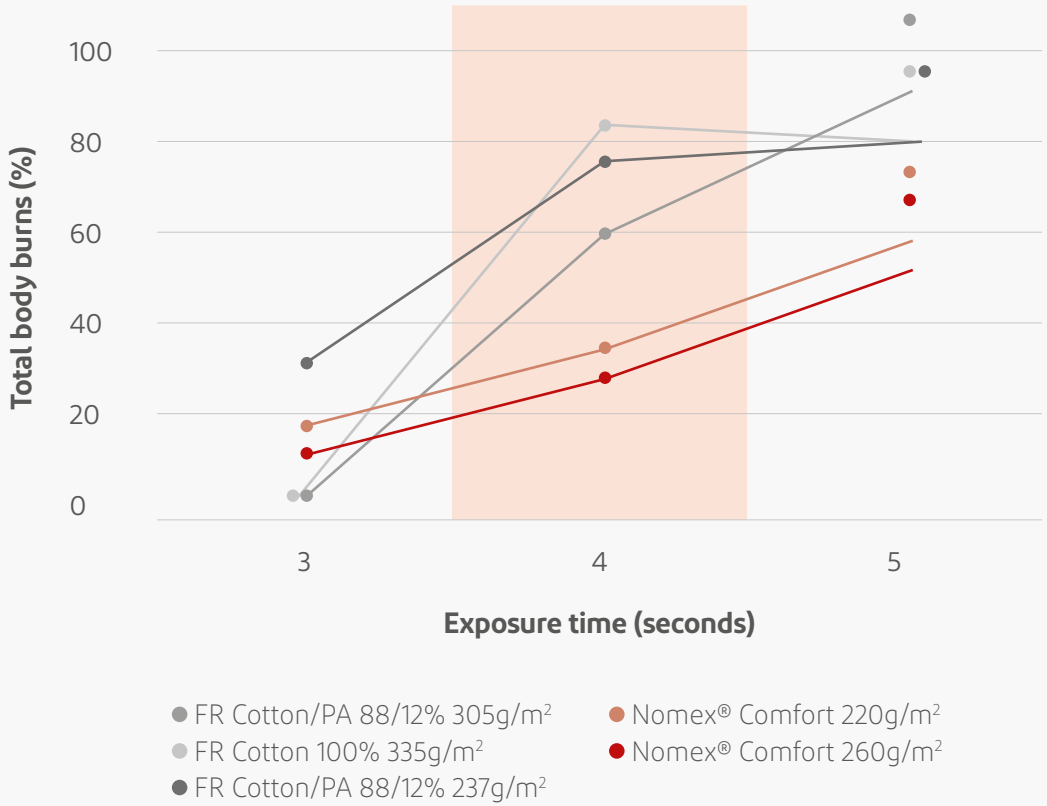
Thermal Protection Performance

Nomex® shields the wearer from heat and flame and protects him from body burns. In DuPont™ Thermo-Man® tests, typically lighter Nomex® garments demonstrate up to 35% less 2nd and 3rd degree body burns than typically heavier flame retardant (FR) treated cotton garments after an exposure of 4 seconds, as recommended by EN ISO 11612. Wearing protective clothing made of DuPont™ Nomex® considerably increases a victim's survival chances.

Furthermore, the latest Nomex® innovative solutions show similar or even better arc protection values than heavier flame retardant cottons, allowing an excellent performance/ weight ratio for single and multi-layer garments.



THERMAL PROTECTION PERFORMANCE



Tests are conducted according to ISO 13506 on standard coveralls (same style and size worn together with standard short sleeve cotton underwear) which are exposed to heat energy levels of 84 kW/m².

After 4 seconds' Thermo-Man® Exposure



Nomex® Comfort 220g/m²

Nomex® Comfort 260g/m²



FR Cotton/PA 88/12% 237g/m²

FR Cotton/PA 88/12% 305g/m²

FR Cotton 100% 335g/m²

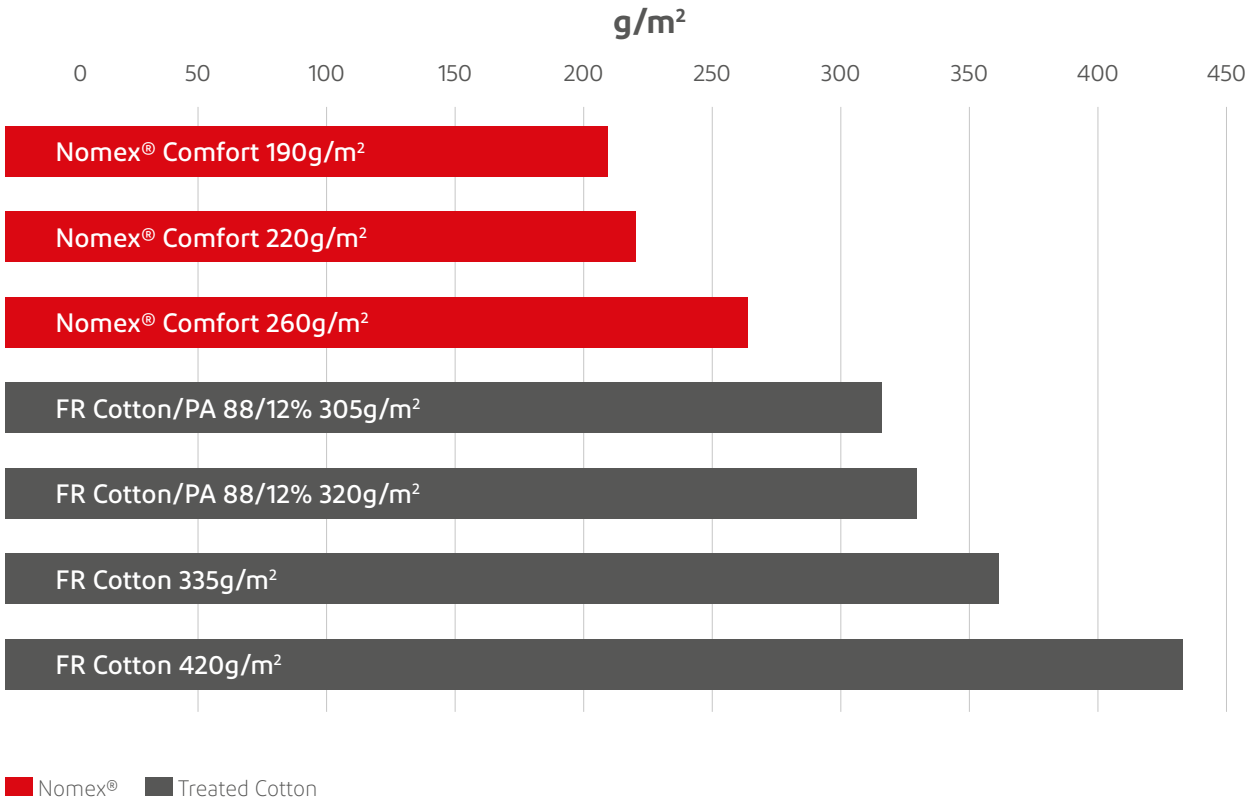
Wearer's Comfort

What feels comfortable may differ from person to person, but one thing is certain: if a garment is uncomfortable, it detracts from the wearer's ability to work efficiently, or may not be worn at all.

DuPont™ Nomex® innovative fabrics and garments are designed by experts with this in mind.

Fabric weight

Basis weight of industrial PPE fabrics



Weighing between 150 and 260g/m², typical Nomex® solutions are up to **40% lighter** than FR cotton and cotton blend fabrics, and therefore **more comfortable** to wear.



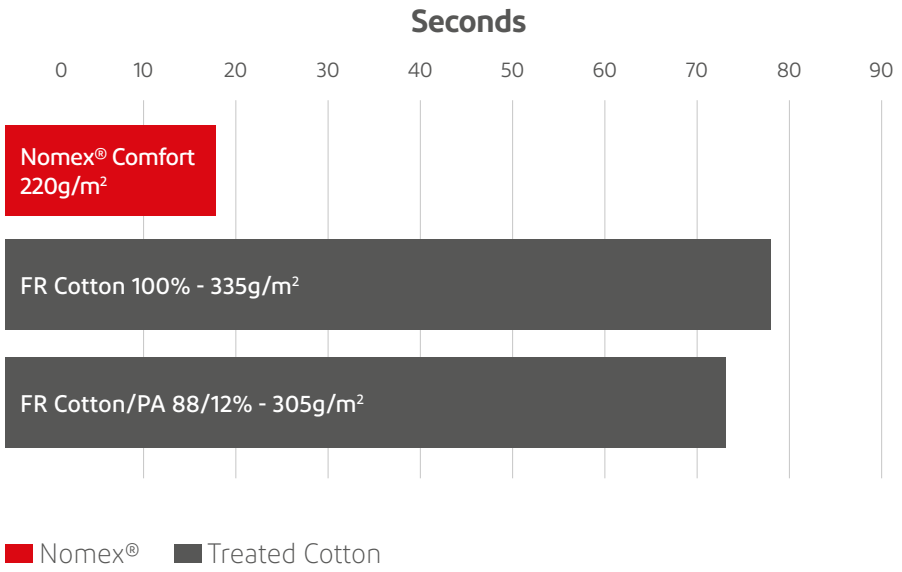
Wearer's Comfort

DuPont™ Nomex® fabrics and garments enable lightweight solutions with excellent moisture management.

Innovative Nomex® fabrics dissipate sweat much more quickly than other solutions, **making the wearer feel dry and more comfortable.**

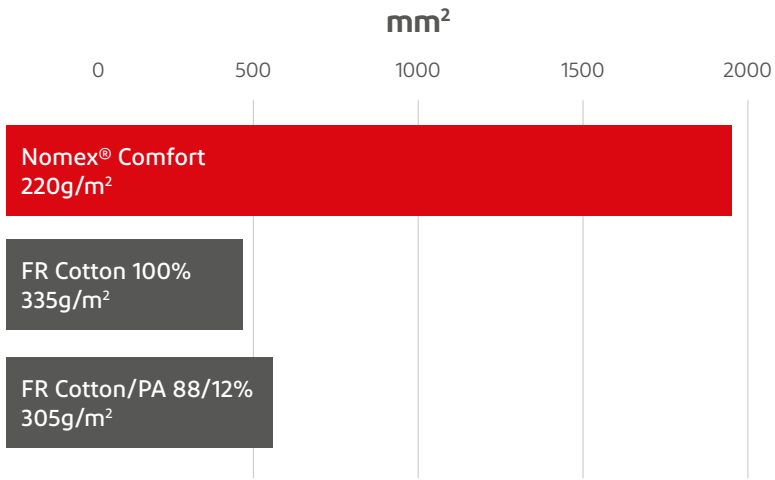
Moisture management

Sweat wicking time



Moisture management

Sweat propagation after 1 minute



Cost-Effectiveness

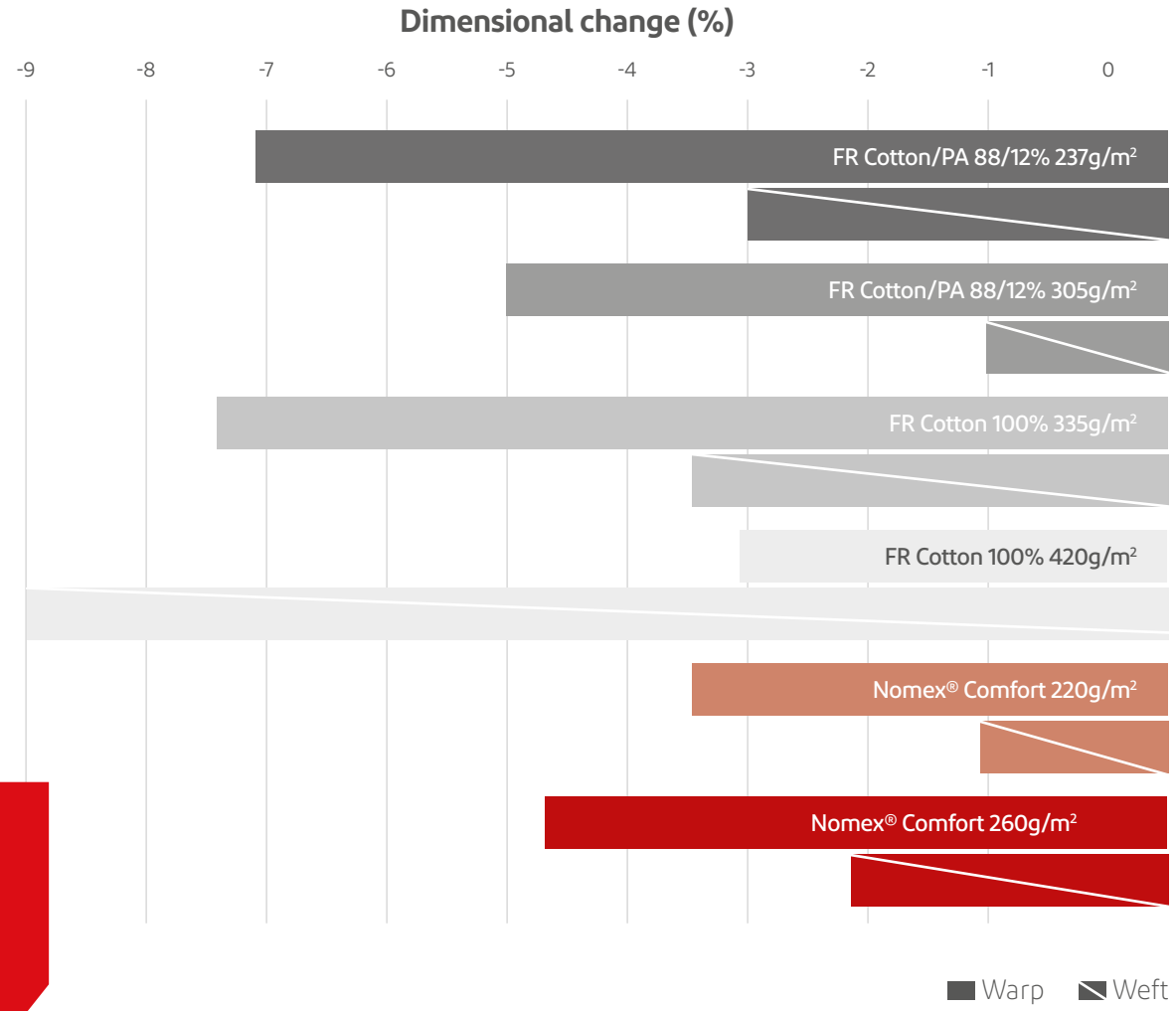
DuPont™ Nomex® is a highly cost-effective solution in terms of cost per wear thanks to its exceptional durability.

Nomex® garments offer better strength and lower shrinkage after washing and drying than FR cotton. This leads to an excellent professional appearance over a longer lifetime.

Suitable for home or industrial laundry, Nomex® garments retain their inherent benefits throughout many washes, guaranteeing the same level of protection throughout their service life.

Less shrinkage

Dimensional change after 50 wash cycles



Nomex® shows excellent performance in shrinkage compared to FR cottons, contributing to a higher durability of garments.

Peace of Mind

Backed by a name you can trust:

Nomex® is made by DuPont, a recognized world-leader in the field of safety, with over 40 years' experience in the protective apparel market.

In Europe, DuPont™ Nomex® solutions are tested and monitored at the company's European Technical Center in Switzerland.

The Nomex® Quality Assurance:

Nomex® labelled garments are produced according to the highest technical standards using fabrics approved by DuPont and have become an integral part of keeping people protected at work. Certified Nomex® fabrics are visible to the end-user through the distinctive Nomex® labelling program:

DUPONT
Nomex®



As fabric construction and garment design play an important role in safety, DuPont works in close collaboration with carefully selected European partners – under the DuPont™ Nomex® Partner Program - to deliver the highest quality Nomex® solutions, ensuring maximum protection and peace of mind. This quality promise on products made of Nomex® based fabrics, together with the high standard of customer-oriented service, are represented by the **Nomex® Partner label** displayed inside the garments.

Nomex® solution portfolio

For more than 50 years, garments made with Nomex® have been advancing the performance of protective FR and arc flash PPE. Building on this legacy, Nomex® is offering a tested and proven portfolio of protective solutions for workers in the industries with uncompromising and unparalleled protection and comfort.

When it comes to FR protection, Nomex® continues to meet and exceed global standards for protection and performance - providing safety managers with peace of mind and industrial manufacturers with the confidence to get the job done. That's why so many industry-leading companies trust Nomex® to keep their electricians safe.

Nomex® Essential

Nomex® Essential is engineered to provide workers in various industrial sectors valuable escape time and protection against intense heat and flames from on-the-job hazards. Nomex® Essential delivers highly durable and lightweight protection.

Nomex® Essential Arc

Nomex® Essential Arc is engineered to provide arc flash protection for workers performing electrical tasks in various industries, utilities and the petrochemical industry. Along with its mechanical properties, it also enhances the durability of the garments, which means less replacements. Nomex® Essential Arc delivers reliable arc flash protection for electricians all around the world.

Nomex® Comfort

The unique fabric technology of Nomex® Comfort provides extreme performance in a lightweight, breathable fabric with built-in flame resistance - making it the ideal choice for protection in various industries. Nomex® Comfort delivers unparalleled protection and comfort.

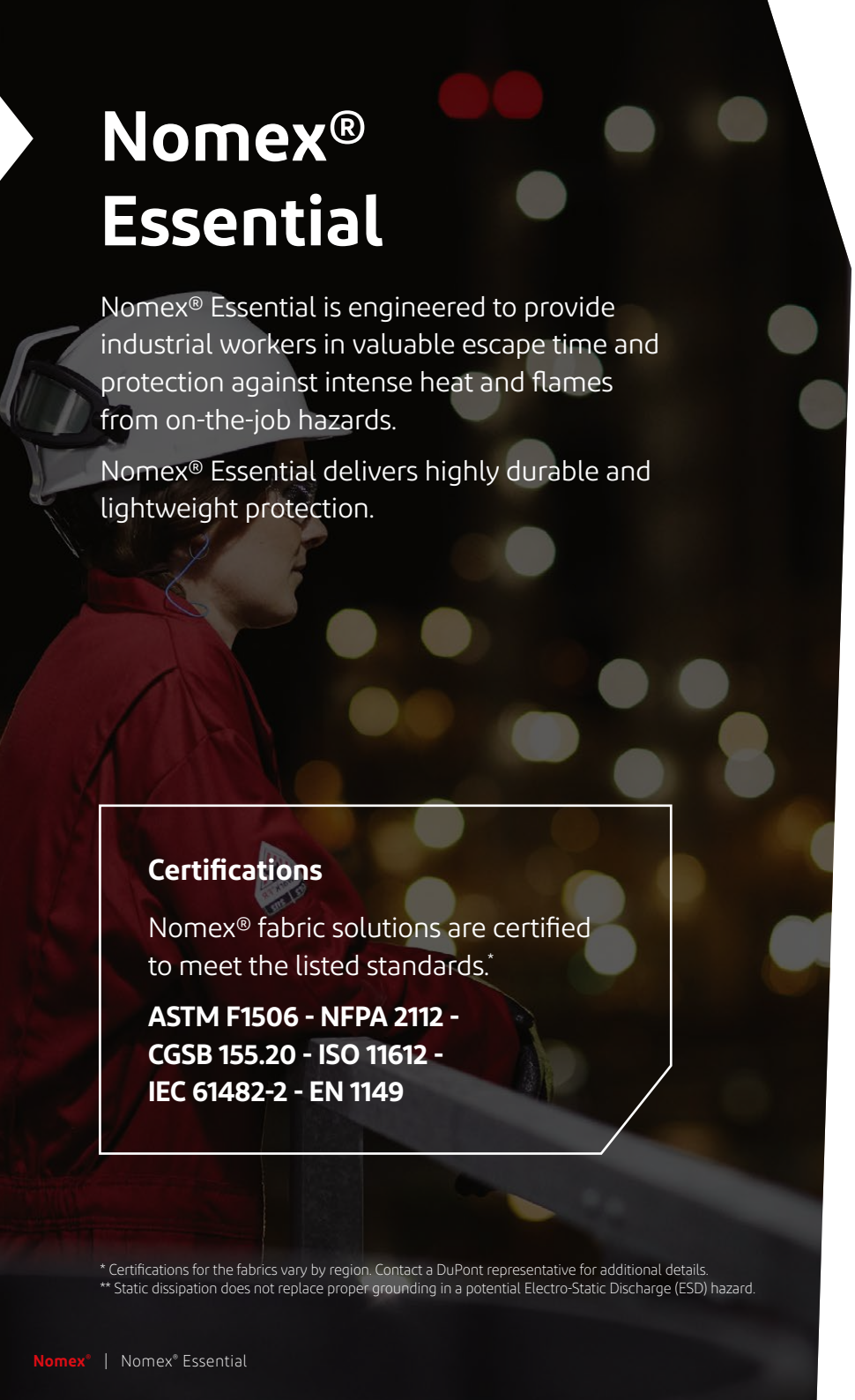
Nomex® Arc

Nomex® Arc is a superior dual-hazard protective fabric that provides electricians in the different industrial sectors with comfortable arc and flame protection from a range of thermal hazards. It delivers reliable >8 cal/cm^2 ATPV arc flash protection, along with its Nomex® legacy thermal protection. Nomex® Arc delivers arc flash protection without compromising its flame protection.

Nomex® Xtreme Arc

ntroducing the most innovative Nomex® offering for arc flash and FR protection. Nomex® Xtreme Arc provides an ATPV of 12 to 19 cal/cm^2 making it the ideal choice for workers confronted with high-risk electrical exposure such as in the oil and gas and others. Nomex® Xtreme Arc delivers high-performance single-layer comfortable electric arc protection.

The Nomex® Xtreme Arc and Nomex® Arc doubleface fabric technology sacrifices the external face to protect the internal face after exposure to arc flash. This technology reduces burn severity, increasing overall protection for workers.



Nomex® Essential

Nomex® Essential is engineered to provide industrial workers in valuable escape time and protection against intense heat and flames from on-the-job hazards.

Nomex® Essential delivers highly durable and lightweight protection.

Certifications

Nomex® fabric solutions are certified to meet the listed standards.*

ASTM F1506 - NFPA 2112 - CGSB 155.20 - ISO 11612 - IEC 61482-2 - EN 1149

* Certifications for the fabrics vary by region. Contact a DuPont representative for additional details.
** Static dissipation does not replace proper grounding in a potential Electro-Static Discharge (ESD) hazard.

Protection

- Better protection at longer exposures and higher temperatures
- Inherent heat and flame resistance
- Inherent protection; can't be washed out or worn away
- Resists tears and abrasion
- Helps provide valuable escape time
- Extremely durable and long-lasting protective solutions

Hazards

- Arc flash
- Short-duration thermal exposure
- Static electricity*
- Hot working conditions
- Combustible dust

Color

Refer to fabric sample for true color representation.

Navy | Royal blue | Red | Khaki

Weight

4.5 oz/yd² / 153 g/m²
6 oz/yd² / 203 g/m²

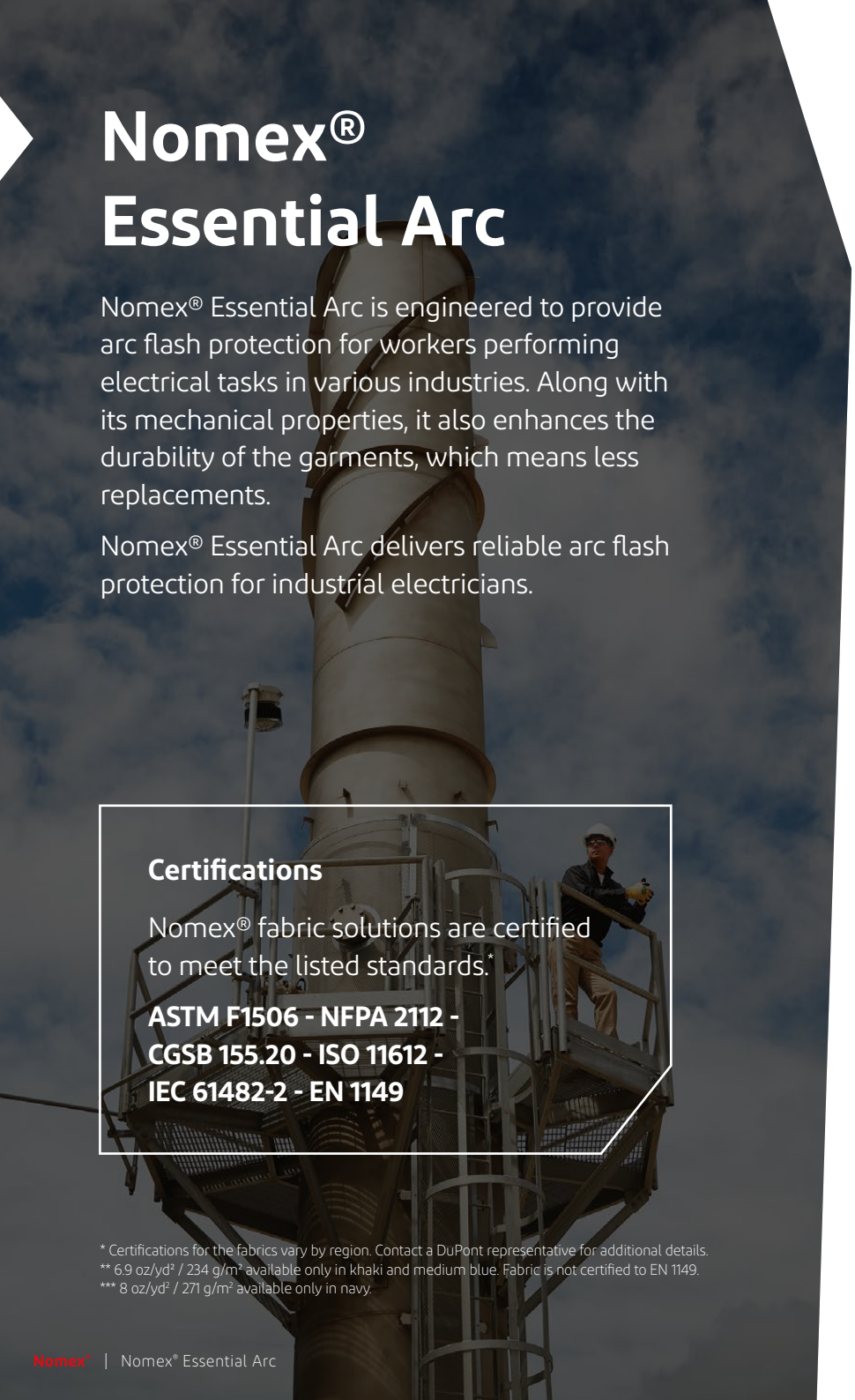
Fiber blend

Nomex®, Kevlar®, antistatic fiber

Nomex® Essential Arc

Nomex® Essential Arc is engineered to provide arc flash protection for workers performing electrical tasks in various industries. Along with its mechanical properties, it also enhances the durability of the garments, which means less replacements.

Nomex® Essential Arc delivers reliable arc flash protection for industrial electricians.



Certifications

Nomex® fabric solutions are certified to meet the listed standards.*

ASTM F1506 - NFPA 2112 - CGSB 155.20 - ISO 11612 - IEC 61482-2 - EN 1149

Protection

- Arc flash protection along with heat and flame resistance
- Better protection at longer exposures and higher temperatures
- Inherent protection; can't be washed out or worn away
- Resists tears and abrasion
- Extremely durable and long-lasting protective solutions

Hazards

- Arc flash
- Short-duration thermal exposure
- Static electricity*

Color

Refer to fabric sample for true color representation.

Navy*** | Medium blue | Royal blue | Dark grey | Khaki | Orange

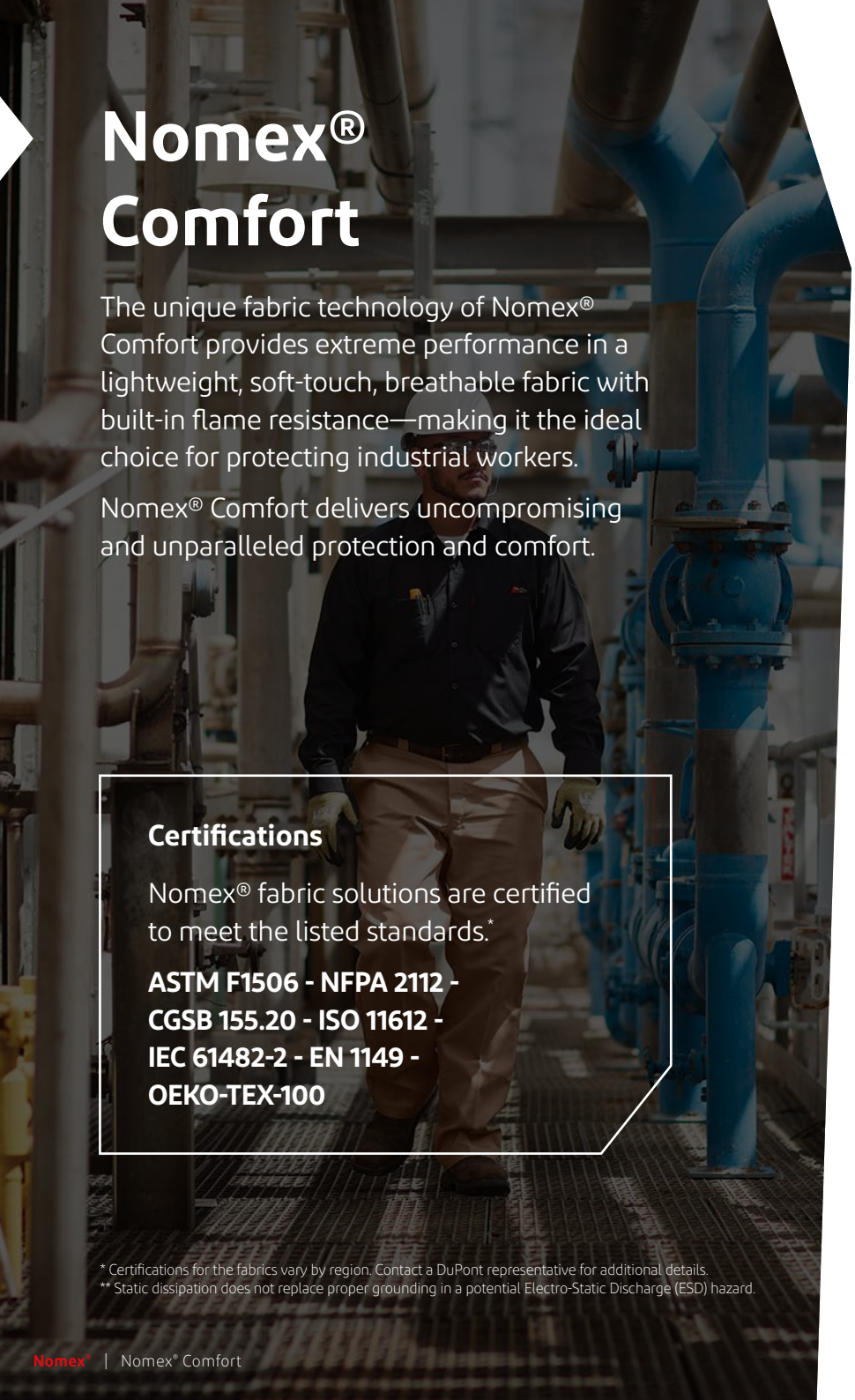
Weight

6.5 oz/yd² / 220 g/m²
8 oz/yd² / 271 g/m²

Fiber blend

Nomex®, Kevlar®, modacrylic, antistatic fiber

* Certifications for the fabrics vary by region. Contact a DuPont representative for additional details.
** 6.9 oz/yd² / 234 g/m² available only in khaki and medium blue. Fabric is not certified to EN 1149.
*** 8 oz/yd² / 271 g/m² available only in navy.



Nomex® Comfort

The unique fabric technology of Nomex® Comfort provides extreme performance in a lightweight, soft-touch, breathable fabric with built-in flame resistance—making it the ideal choice for protecting industrial workers.

Nomex® Comfort delivers uncompromising and unparalleled protection and comfort.

Certifications

Nomex® fabric solutions are certified to meet the listed standards.*

ASTM F1506 - NFPA 2112 - CGSB 155.20 - ISO 11612 - IEC 61482-2 - EN 1149 - OEKO-TEX-100

* Certifications for the fabrics vary by region. Contact a DuPont representative for additional details.
** Static dissipation does not replace proper grounding in a potential Electro-Static Discharge (ESD) hazard.

Protection

- Better protection at longer exposures and higher temperatures
- Inherent heat and flame resistance
- Inherent protection; can't be washed out or worn away
- Resists tears and abrasion
- Helps provide valuable escape time
- Extremely durable and long-lasting protective solutions

Hazards

- Arc flash
- Short-duration thermal exposure
- Static electricity*
- Hot working conditions
- Combustible dust

Color

Refer to fabric sample for true color representation.

Navy | Royal blue | Red | Khaki | Orange

Weight

4.5 oz/yd² / 153 g/m²
5.3 oz/yd² / 180 g/m²

6 oz/yd² / 203 g/m²
6.6 oz/yd² / 225 g/m²

Fiber blend

Nomex®, Kevlar®, antistatic fiber

Nomex® Arc

Nomex® Arc is a superior dual-hazard protective fabric that provides industrial electricians with comfortable arc and flame protection from a range of thermal hazards. It delivers reliable >8 cal/cm² ATPV arc flash protection, along with its Nomex® legacy thermal protection.

Nomex® Arc delivers arc flash protection without compromising its flame protection.

Certifications

Nomex® fabric solutions are certified to meet the listed standards.*

ASTM F1506 - NFPA 2112 - CGSB 155.20 - ISO 11612 - IEC 61482-2 - EN 1149 - OEKO-TEX-100

Protection

- Arc flash protection along with heat and flame resistance
- Better protection at longer exposures and higher temperatures
- Inherent protection; can't be washed out or worn away
- Resists tears and abrasion
- Extremely durable and long-lasting protective solutions

Hazards

- Arc flash
- Short-duration thermal exposure
- Static electricity**

Color

Refer to fabric sample for true color representation.

Navy | Royal blue | Khaki | Orange

Weight

6.5 oz/yd² / 220 g/m² (woven)
6.9 oz/yd² / 234 g/m² (knitted)***

Fiber blend

Nomex®, Kevlar®, antistatic fiber

* Certifications for the fabrics vary by region. Contact a DuPont representative for additional details.
** Static dissipation does not replace proper grounding in a potential Electro-Static Discharge (ESD) hazard.
*** 6.9 oz/yd² / 234 g/m² available only in khaki and medium blue. Fabric is not certified to EN 1149.

Nomex® Xtreme Arc

Introducing the most innovative Nomex® offering for arc flash and FR protection. Nomex® Xtreme Arc provides an ATPV of 12 to 19 cal/cm², making it the ideal choice for workers confronted with high-risk electrical exposure in utilities, industrial manufacturing and oil and gas.

Nomex® Xtreme Arc delivers high-performance single-layer comfortable electric arc protection.

Certifications

Nomex® fabric solutions are certified to meet the listed standards.*

ASTM F1506 - NFPA 2112 - CGSB 155.20 - ISO 11612 - IEC 61482-2 - EN 1149

Protection

- Arc flash protection along with heat and flame resistance
- Better protection at longer exposures and higher temperatures
- Inherent protection; can't be washed out or worn away
- Resists tears and abrasion
- Extremely durable and long-lasting protective solutions

Hazards

- Arc flash
- Short-duration thermal exposure
- Static electricity**

Color

Refer to fabric sample for true color representation.

Paris blue | Sunset blue | True grey

Weight

6.5 oz/yd² / 220 g/m² (woven)***
6.9 oz/yd² / 234 g/m² (knitted)

Fiber blend

Nomex®, Kevlar®, antistatic fiber

* Certifications for the fabrics vary by region. Contact a DuPont representative for additional details.
** Static dissipation does not replace proper grounding in a potential Electro-Static Discharge (ESD) hazard.
*** CGSB 155.20 certification pending.

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APPENDICES



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APPENDIX 1

CE markings, European standards and legislative framework

Duty of care

Employers have a Duty of Care to their employees and must take all reasonable and practicable steps to ensure the health and safety of staff in the workplace. This means that it is not sufficient to merely be in compliance with the basic health and safety legislation that is in place which might be unsuitable, inadequate or simply out of date. Employers are obligated to keep abreast with contemporary knowledge and technology and be fully conversant with potential workplace risks. Note that failure to comply with health and safety legislation can be a criminal offence and in particular, individual directors and company officers may have a personal responsibility and liability under certain national laws such as the UK Health and Safety at Work etc. Act 1974.

Regulations often impose absolute obligations on employers to put specific safety measures in place or to avoid particular hazards. As a consequence, employers are required to implement a management system for identifying and managing any exposures, or potential exposures, to risks and, in practice, this invariably means that adequate risk assessment exercises have to be carried out and documented on a periodic basis (please see Appendix 2).

Technical standards and their limitations

Standards, particularly international standards, play a vital role in ensuring that certain agreed and minimum standards of quality, interoperability and performance are adhered to. This is in order to protect both the consumer and the environment, and to facilitate the transfer of trade and technology. However, although common standards play a huge role in the specification of protective apparel and other safety equipment, it is not possible to select protective clothing for a given hazard situation simply by relying on industry-wide standards or certifications.

This is partly due to the fact that there can be very wider anging quality and performance latitudes within a given Standard and these permitted margins can equate to big differences in product capabilities.

For example, there is a huge number of protective suits available commercially and although each may carry the European-wide CE mark, there are very wide ranging performance differences for products meeting the same certification "Type". For example for the Type 5, 80% inward leakage average results must be lower than 15% of inward leakage. The same applies to the different garment 'Classes' relating to nuclear particulate protection where the very broad performance spans of the three bands render them, at best, a very blunt instrument for evaluating the relative performance of different garments (please see Appendix 5 - Nominal Protection Factor).

From this it is easily seen that the allocation of a garment to a specific protection type does not necessarily provide an indication that all suits of this type offer the same protection. It is also important to understand that a CE mark in itself does not signify 'approval' of any kind. The former EU legislation in the form of Directive 89/686/EEC and new PPE Regulation (EU) 2016/425 make these limitations abundantly clear and in its own words says that the documents merely defines "the basic requirements to be satisfied by personal protective equipment". In other words it represents the 'bare minimum' rather than the ideal or preferred protective standard. Such standards therefore correspond to an absolute 'entry level' of garment performance and represent only a baseline, or starting point, for satisfactory garment selection. There are other limitations relating to standards which should also be understood. These include:

Standards, and international standards in particular, take a long time to develop, agree and harmonise. The requirement for lengthy consultation periods adds to the problem. The same applies to their subsequent review and revision. This means that standards tend to be quickly out of date and out of line with technological developments, modern safety criteria and the latest scientific knowledge in the market place.

Although some standards may be performance-driven, as opposed to specification-driven, and are claimed to be flexible enough to be independent of technical progress, in practice the "lowest common denominator" effect of standards can serve to mitigate against innovation and creativity. Their prescriptive nature tends to force manufacturers along set paths when there may be other options and solutions that are as good, or better than those dictated by a prescriptive standard.

- Compliance with a standard, while generally representing a minimum acceptable quality level, can confer unwarranted credibility and status to companies and products that are not necessarily of a good merit. An 'ISO' certificate, for example, is, in itself, no guarantee that a company manufactures superior quality products. It merely proves a degree of procedural compliance and this can be a misleading indicator.
- A blind adherence to standards can mitigate against the application of 'common sense' in situations where this is more appropriate.
- Due to their universality, international standards can be open to interpretation since they are enacted across many states (for example, in the case of CE marking, these apply across the entire 31 member states of the European Economic Area).
- International harmonisation results in an 'approximation' of existing national laws and can result in a dilution of some national standards which is detrimental to overall levels of safety.
- Users and specifiers can be lulled into a false sense of security by an over-reliance on published technical standards. The use of standards can lead to 'decision abrogation' and 'accountability transfer'effects due to a myopic over-reliance on the perceived safety attributes of 'certified' products.
- Compliance with standards, especially those involving inordinate amounts of paperwork or high financial outlays, can divert resources away from improving genuine quality and safety issues.
- By practical necessity, standards tend to be data-driven and based on 'recognised test methods', i.e. laboratory tests and simulations, and do not necessarily take into adequate account the real life and in-service aspects of product usage.
- Similarly, many standards are based on a necessarily limited amount of data and risk scenarios which reduces their applicability to all hazard situations.
- Standards, therefore, supplement but are no substitute for a thorough assessment of hazards and the protective options available. All this, however, is not to downgrade the importance of standards. They are absolutely vital tools in establishing minimum safety and quality performance, of ensuring product and process consistency and repeatability, and in establishing cross-industry and cross-market compatibility. It is, however essential to be aware -of their limitations and never use them as an excuse for not conducting a proper evaluation of protective garments or any other PPE.

Mandatory Standards

EU directives such as former Council Directive 89/686/EEC[1] and new PPE Regulation (EU) 2016/425 governing personal protective equipment that is placed on the market, are required to be embraced by companies operating in EU and EEC member countries and enshrined in national law. Such legislation is designed to facilitate the free movement of goods within the Community and ensure that certain basic health and safety requirements are met to protect the end-user (the 'essential requirements').

The general scope of EU Directives/Regulations such as this tends to be wide in nature and ranges from clothing and respiratory protective masks to safety footwear and fall arrest equipment. There are only a very few exclusions to this Directive and these generally relate to specialised equipment already covered by EU legislation.

ISO

An EN standard is essentially a regional Standard. Increasingly, however, European Standards (prefixed EN – European Norm) are being superseded, subsumed or harmonised with International Standards (prefixed ISO). ISO is the International Organization for Standardization which works to develop and translate standards at an international level. There is much co-operation and mutual adoption between ISO and the EU and mutually adopted standards bear the prefix 'EN-ISO'.

CEN

CEN (Comité Européen de Normalisation) is the European Committee for Standardization and is the non- profit body officially vested by the EU to develop cross-border EN standards and specifications. It operates alongside the European Committee for Electrotechnical Standardization (CENELEC) and the European Telecommunications Standards Institute (ETSI) to promote and deliver harmonised standards.

National Standards

These are the standards, such as British Standards (prefixed 'BS'), Deutsche Industrie Norms (prefixed 'DIN') or Norme Française 'NF', that prevail in individual countries. Increasingly, they are being superseded by their European equivalents, in which case they are referred to as 'BS-EN' or 'BS-EN' etc.). Similarly, a standard bearing the prefix 'BS-EN-ISO' refers to a standard containing the same core information in all cases and which has been adopted across all three territorial boundaries - a truly international standard.

Proprietary Standards

As we have seen, and despite their limitations, legislated standards are a powerful means of ensuring wholesale compliance with minimum levels of safety, quality and uniformity. However, commercially astute, customer-focused businesses will always endeavour to aspire to technical specifications, ethical behaviour and levels of customer support that are far in excess of any legal minima. In this way they can differentiate themselves from the 'only-just-good-enough' suppliers and demonstrate their superiority.

Notes

For Information relating to EU ATEX directives (potentially explosive atmospheres) please see Appendix 7. For a summary of the European standards for protective clothing refer to Appendix 7 from British Standards[1].

1HSE online, European Standards and Markings for protective clothing, Appendix 7 (United Kingdom, HSE, 2013).

Interpretation of instructions for use and garment labels

The six Types of protection within Category III chemical protective clothing are intended to facilitate garment selection as a function of nature of the hazard exposure. Certification to a particular protection type represents the tightness of the suit against a particular form of exposure (gas, liquid or dust). However it does not mean that the suit is 100% impervious to a given type of exposure. The whole suit Type-tests merely define a maximum allowable amount of a challenge test liquid, aerosol or particulates to ingress into the garment.

For example, for the Type 5, 80% inward leakage average results must be lower than 15% of inward leakage. Allocation to a specific protection type is therefore not a sign that all protection suits of this type have the same barrier properties. Rather, protection offered by Type 5 suits can differ greatly in terms of the actual particulate barrier they provide, depending on the suit fabric, seam construction, design and whether the testing has been conducted with additional barriers, such as taping around the cuffs, ankles and hood/mask.

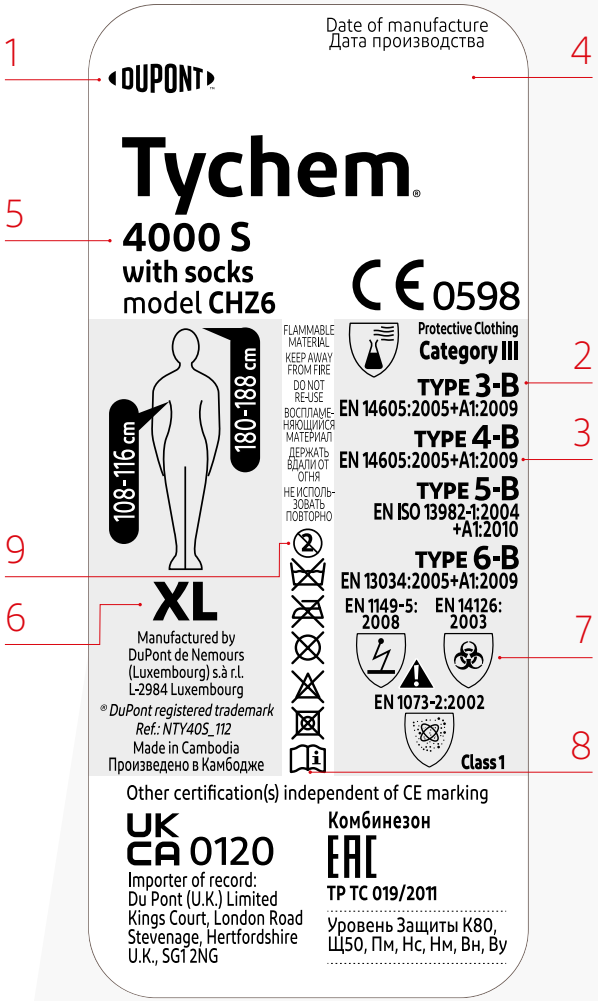
Quality Control

All CE-certified protective clothing has a marking (e.g. product label) and is supplied with a sheet of information by the manufacturer (i.e. Instructions for Use). The content of these two items is checked and released by the notified body that issued the CE marking for the product, and therefore these are official documents. The manufacturer is under obligationto have a Quality Control in place to ensure a regular monitoring of the fabric and garment performance vs the basic health and safety requirements of the Directive / upcoming Regulation.

Marking/labelling attached to garment

Protective clothing for chemicals shall be marked with at least the following information. The marking must be clearly visible and durable for the life of the clothing (please see an exemplary label).

1. the name, trademark or other means of identification of the manufacturer;
2. the Type classification, i.e. Type 6 for chemical splash-protective garments;
3. the number and date of publication of European Standard for the type;
4. the date of manufacture;
5. the manufacturer's type, identification or model number;
6. the size range (as defined in EN 340);
7. a pictogram showing the clothing is for protection against various hazards (here protection against infective agents);
8. a pictogram inviting to read instructions for use and any other information supplied by the manufacturer;
9. re-usable PPE to be marked with care pictograms according to ISO 3758. Limited life PPE is marked with the warning phrase 'Do not re-use' (please see also EN 340).



APPENDIX 2

Protective garments categories, types and classes

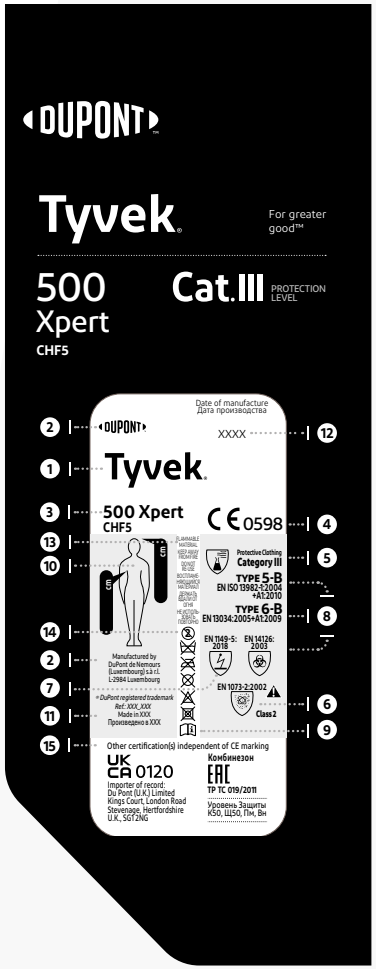
Instructions for Use - information supplied by the manufacturer

This information must accompany every item of chemical clothing or every individual commercial packaging unit. The purpose is to guarantee that the wearer is confronted with these instructions prior to use.

The information must be at least in the official language(s) of the country or region of destination. It must be unambiguous and, if helpful, illustrations, part numbers, marking etc. can be included. If appropriate, warnings should be given against any problems likely to be encountered.

The instructions together with the information on the marking needs to contain at least the following information.

- the name, trademark, or other means of identification, and address of the manufacturer and/or his authorized representative established in the European Union or the country where the product is placed on the market;
- the reference number of the European Standard for the Type;
- the Type, e.g. Type 6 for light chemical splashes – protective suits;
- if applicable, additional items of personal protective equipment to be worn to ensure the level of protection needed and how to attach them;
- the manufacturer's type, identification or model number;the size range (as defined in EN 340);
- the names of chemicals and chemical products (including the names and approximate concentrations of the components) to which the protective clothing has been tested. This will include the performance levels obtained for liquid repellency and penetration for each chemical tested. If additional information is available, a reference to where this information can be obtained (e.g. manufacturer's telephone, fax number or website) shall be added;
- all other performance levels, as specified in Type defining norm, preferably in a table;
- a statement that chemical protective garments have been tested to the whole-suit test;
- for re-usable items: the explanation of care pictograms according to ISO 3758 and additional information on cleaning and disinfection (please see also EN 340, 5.4);
- the expected shelf-life of the garment if ageing can occur;
  - information necessary for trained persons on:
  - application, limitations of use (temperature range, antistatic properties etc.)
  - tests to be carried out by the wearer before use (if applicable)
  - fitting
  - use
  - removal
  - maintenance and cleaning (including guidance for decontamination and disinfection
  - storage
- if applicable, a statement to advise that the prolonged wearing of chemical protective suits may cause heat stress



EN • Instructions for Use
DE • Gebrauchsanweisung
FR • Consignes d'utilisation
IT • Istruzioni per l'uso
ES • Instrucciones de uso
PT • Instruções de utilização
NL • Gebruiksinstructies
NO • Bruksanvisning
DA • Brugsanvisning
SV • Bruksanvisning
FI • Käyttöohje
PL • Instrukcja użytkowania
HU • Használati útmutató
CS • Návod k použití
BG • Инструкции за употреба
SK • Pokyny na použitie
SL • Navodila za uporabo
RO • Instrucțiuni de utilizare
LT • Naudojimo instrukcija
LV • Lietošanas instrukcija
ET • Kasutusjuhised
TR • Kullanım Talimatları
EL • Οδηγίες χρήσης
HR • Upute za uporabu
SR • Uputstvo za upotrebu
RU • Инструкция по применению

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The relationship between Garment categories, Types and Classes

In accordance with PPE Regulation (EU) 2016/425, it is an employer's responsibility to lay down minimum requirements for the assessment, selection and correct use of personal protective equipment. Priority must be given to collective safety measures.The following table provides you with a rule of thumb of how to assess risk in the garment selection process:

Garment 'Categories'

PPE Regulation (EU) 2016/425 refer to three "Categories of PPE". These Categories are shown in the figure and demonstrate that the manufacturer of the product concerned has complied with the relevant performance requirements. In terms of protection, these categories relate to the protective properties of the entire garment where Category I offers the least protection and Category III relates to the highest protection. With Category III garments, in addition to the basic CE certification (according to Module B - Annex V of the PPE Regulation, the manufacturer must ensure the product continues to conform and meet the the declared performance EN Classes shown in the Instructions for use. Unlike Category I and II PPE, Category III PPE is subject to an annual audit by a Notified Body, which certifies continued conformity and issues a "Quality Surveillance Certificate" as per Module C2/D - Annex VII/VII of the PPE Regulation. Note that all Category III PPE must be identified with the digit code of the notified body appended to the CE mark.

Table 1 **Risk assessment determines required garment performance.**

Level of exposure	→	Garment type* *please see Appendix 5*
Hazard/toxicity	→	Fabric barrier properties* *please see Appendix 3*
Level of exposure	→	Mechanical fabric properties *please see Appendix 3*

Table 2 **Categories of PPE and compliance with garment performance requirements.**

PPE Category (Regulation (EU) 2016/425)	Definition	Logo	Initial EC-Type Certification from a notified body (Module B - Annex V**)	Manufacturer's declaration of Confirmity (Annex IX**)	Annual Quality Surveillance Certification by a notified body (Module C2/D - Annex VII/VIII**)
Category III (PPE of complex design)	Includes exclusively risks that may cause very serious consequences such as death or irreversible damage to health	CE XXXX**	Mandatory	Yes	Yes
Category II (neither simple nor complex PPE)	Protection against moderate risk where the product is tested for one value e.g. water resistant gloves or reflective tape for garments.	CE XXXX**	Mandatory	Yes	Surveillance certification required every 5 years or in case of product modification
Category I (PPE of simple design)	Protection from minimal risks, self certification of products, exposure to dirt and grime e.g. gardening gloves, visitors' labcoats.	CE	Not required	Yes	Not required

[1]OSHA online, Council Directive 89/656/EEC on the minimum health and safety requirements for the use by workers of personal protective equipment at the workplace
[2]European Commision online, Council Directive 89/686/EE on Personal Protective Equipment.
* Garment Type is linked to fabric barrier properties. ** Represents the 4 digit numeric code of the notified body.

Garment Types

To facilitate the selection of Category III protective clothing are split into six levels of protection ('Types') with each Type being associated with a defined 'level of exposure' have been defined. Type I represents the 'highest' level of protection down to Type 6 which generally offers the 'lowest'. The six exposure levels are designed to equate to different modes of exposure to increasingly serious threats and are a frequently referred-to when specifying protective coveralls.

When selecting or specifying a Category III garment it is often referred to by its CE 'Type' certification. However this is not sufficient for an appropriate garment selection. Different protective garments that all meet the standards do not necessarily offer the same protection performance (please see Appendix 3). Different protective clothing products produced in compliance to a specific CE 'Type' can exhibit very different protection, durability and comfort performance characteristics. The CE 'Type' designation simply implies that a suit has passed one or more of the defined 'whole-suit' tests and meets the minimum mechanical and barrier requirements.

Table 3 **Protection Types in Category III, chemical protective clothing.**

Chemical Protective Clothing, Category III

Type and Pictogram*	Definition and Exposure Level	Product Standard and Year of publication
 **TYPE 1** **TYPE 1 - ET**	Gas-Tight TYPE 1 – Protective clothing against liquid and gaseous chemicals, including liquid aerosols and solid particles. TYPE 1 - ET – Performance requirements for emergency teams.	EN 943-1:2019** EN 943-2:2019
 **TYPE 2**	Non-Gas-Tight Protective clothing against liquid and gaseous chemicals, including liquid aerosols and solid particles.	EN 943-1:2019**
 **TYPE 3**	Liquid Tight Protective clothing against liquid chemicals. Exposure to pressurised jet of liquid.	EN 14605:2005/A1:2009
 **TYPE 4**	Spray Tight Protective clothing against liquid chemicals. Exposure to a liquid spray aerosol (unpressurised).	EN 14605:2005/A1:2009
 **TYPE 5**	Solid Particulates Protective clothing against solid-airborne particulates.	EN ISO 13982-1:2004/A1:2010
 **TYPE 6**	Limited protective performance against liquid chemicals Potential exposure to small quantities of fine spray/mist or accidental low volume splashes and where wearers are able to take timely adequate action in case of contamination.	EN 13034:2005/A1:2009

* DuPont Pictogram. ** Amended in 2005.

Other Relevant Standards

There are a number of other relevant PPE Standards that are applicable to protective clothing for particular applications and exposure hazards:

Table 4 **Other relevant PPE standards**

Other Relevant Standards		
Pictogram	**Definition**	**Standard and Year***
 **	Protective Clothing with Electrostatic properties – material performance and design requirements.	EN 1149-5:2018
 ***	Protective clothing against radioactive contamination.	EN 1073-2 :2002
	Protective Clothing with protection against heat and flame-Limited flame spread materials, material assemblies and clothing. Three 'Index' (levels) of protection are defined Index 1/0/0 → Index 1 performance, single use and no pre-cleaning or laundering. Index 1 materials limit the flame spread, but will melt and must always be worn on top of Index 2 or 3 garments.	EN ISO 14116:2008
	Protective clothing (fabrics) against infective agents (indicate by a 'B' e.g. Type 3-B) and comprising several fabric protection test methods.	EN 14126:2003

Notes

For information on radioactive particulate protection please see Appendix 5.

Fabric 'Classes'

In addition to the overall garment performance, the European standard for each garment Type also specifies a number of minimum performance requirements, known as the performance Class for the constituent fabrics and seams. These performance properties include technical attributes such as abrasion resistance, puncture resistance, tensile strength, and chemical permeation and penetration (please see Appendix 4). Each fabric property has usually between 1 and 6 performance Classes where Class 6 relates to the highest performance and Class 1 to the minimum performance requirement. This classification system for the fabric helps specifiers to differentiate between different functional characteristics.

These mechanical properties are a very important part of the protection equation because they introduce a 'durability' factor into the garment appraisal. Because fabric barrier tests are conducted on brand-new garments under static conditions, they do not indicate whether a barrier property will be maintained over time under real working conditions. Protective garments must perform from the moment they are put on to the moment they are taken off and in an operating environment they can be subject to stresses which might compromise the protective performance e.g. by abrasion or tearing.

* As standards are continuously revised the year of publication is subject to change.
** Antistatic treatments on DuPont chemical protective clothing are only effective in relative humidity >25% and when the garment and wearer are continuously and correctly grounded.
*** Does not protect against ionizing radiation.

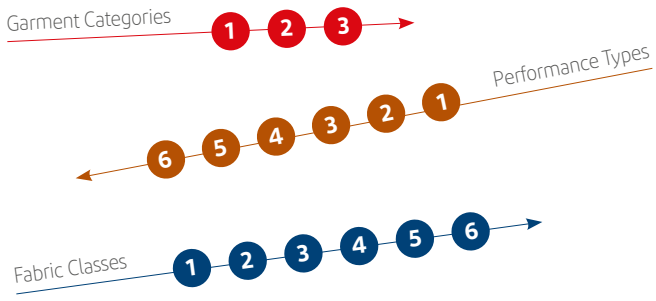
Table 5 **Mechanical performance tests.**

	Test method	Norm	Scope/Principle
Durability	Abrasion resistance	EN 530 Method 2	Abrasion is the physical destruction of fibers, yarns, fabrics resulting from the rubbing of the fabric suface over an abrasive glass paper. It ultimately affects the appearance of the fabric and results in the loss of performance properties after a number of cycles.
	Flex cracking resistance	EN ISO 7854 Method B	Flex cracking simulates repeated flex and folds in the fabric. The number of cycles to failure indicated by cracks and holes is recorded.
	Tear resistance	EN ISO 9073-3	Tear resistance determines the trapezoid tear resistance of a fabric by applying a continuously increasing extension in such a way that a tear propagates across the width.
	Tensile strength	EN ISO 13934-1	Tensile strength determines the maximum force and elongation at maximum force of the fabric using a strip method. The fabric is extended at a constant rate until it ruptures.
	Puncture resistance	EN 863	Puncture records the maximum force required to push a spike through the fabric with a constant rate until it perforates.
	Seam strength	EN ISO 13935-2	Seam strength determines the maximum force of sewn seams when the force is applied perpendicularly to the seam which is extended until it ruptures.
Protection	Penetration by liquids	EN ISO 6530	Gutter test method determines indices of penetration, repellency and absorption by applying a fine stream of a test liquid to the surface of a clothing material resting in a inclined gutter.
	Permeation by liquids	EN ISO 6529 Method A	Permeation test method determines breakthrough detection time at normalized permeation rate and cumulative mass by analysing quantitatively the chemical concentration that has permeated after initial continuous contact with the chemical.
	Surface resistance	EN 1149-1	Antistatic test method is intended for materials used for electrostatic dissipative protective clothing to avoid incendiary discharge. A potential is applied to an electrode assembly rested on the fabric placed on an insulating base plate and the resistance of the fabric is recorded. The lower the resistance, the better the electrostatic dissipation performance.

A word of caution

It can be seen that there is a degree of inconsistency between the three classifications in that both the garment EN Categories and the fabric Classes use a rating scale where Level 1 represents the lowest level of protection and the highest number represents the highest level of protection. Paradoxically, however, the garment Type scale works the other way round with a Type 1 classification, i.e. the lowest number, referring to the highest level of protection! This anomaly can be very confusing to the specifier or user and it can be helpful to use some form of mnemonic or visual Aid Memoire to avoid mistakes.

Figure 1 Visual Aid Memoire on garment Categories, performace Types and fabric Classes, **Source:** DuPont



APPENDIX 3

Fabrics types and properties

Informational properties		
Basis weight	EN ISO 536	g/m²
Thickness	EN ISO 534	µm
Resistance to water penetration	EN 20811	cm H_2O
Bursting strength	ISO 2758	kPa
Air permeability (Gurley)	ISO 5636-5	s
Water vapour resistance, Ret	EN 31092	m².Pa/W

Some of the physical properties of PPE fabrics are categorised under the fabric Classes mentioned in Appendix 2. Whole garment performance is covered in Appendix 5. For information on fabric test methods *please see Appendix 4.*

Differents fabric properties

No matter what the brand or trade name, the majority of limited-use protective clothing products can be classified into one of a small number of broad fabric technologies. Although they may look the same, it is very important to realise that, in practice, these different technologies exhibit widely varying performance attributes. As a result a garment specifier or user must have a clear understanding of the technical properties of the various materials that might be considered for a given application.

Some protective fabrics, such as DuPont™ Tychem® and DuPont™ Tyvek® employ advanced proprietary technologies that have been specifically developed to provide a wide range of performance and comfort options to suit particular needs. Other fabrics are typically based on generic nonwovens and microporous films.

In order to select the appropriate protective garment, it is essential to understand how effectively a particular fabric performs as a barrier to specific hazardous materials. For details of Penetration Testing and Permeation Testing please refer to Appendix 4. To compare the physical attributes of the Category III garment Type 3, 4, 5 or 6 refer to the following table which shows minimum requirements for CE properties vs Type and informational characteristics.

Table 6 **Minimum requirements for CE properties versus Type and informational characteristics.**

	Test method	Norm	Unit	Type 6	Type 5	Type 4	Type 3
Durability	Abrasion resistance	EN 530 Method 2	cycles	Class 1 >10 cycles	Class 1 >10 cycles	Class 1 >10 cycles	Class 1 >10 cycles
	Flex cracking resistance	EN ISO 7854 Method B	cycles	X	Class 1 >1000 cycles	Class 1 >1000 cycles	Class 1 >1000 cycles
	Tear resistance	EN ISO 9073-3	N	Class 1>10 N	Class 1>10 N	Class 1>10 N	Class 1>10 N
	Tensile strength	EN ISO 13934-1	N	Class 1>30 N	X	Class 1>30 N	Class 1>30 N
	Puncture resistance	EN 863	N	Class 1>5 N	Class 1>5 N	Class 1>5 N	Class 1>5 N
	Seam strength	EN ISO 13935-2	N	Class 1>30 N	Class 1>30 N	Class 1>30 N	Class 1>30 N
Protection	Penetration by liquids	EN ISO 6530	%	Class 2<5%	X	X	X
		EN ISO 6530	%	Class 3>95%	X	X	X
	Permeation by liquids	EN ISO 6529 Method A	min	X	X	Class 1>10 min	Class 1>10 min
	Surface resistance	EN 1149-1	Ω	<2.5E+09 optional	<2.5E+09 optional	<2.5E+09 optional	<2.5E+09 optional

DuPont™ Tyvek®

Manufactured by a flash-spinning process, Tyvek® fabric is made of strong, continuous, high density polyethylene fibres. The fibres are thermally bonded into a tight, homogeneous and soft fabric that is intrinsically breathable, does not shed fibres ('linting') and has inherent barrier properties i.e. not reliant on a thin applied coating or layer. This unique combination of barrier protection and inherent breathability makes Tyvek® an ideal fabric for a wide range of protective applications.

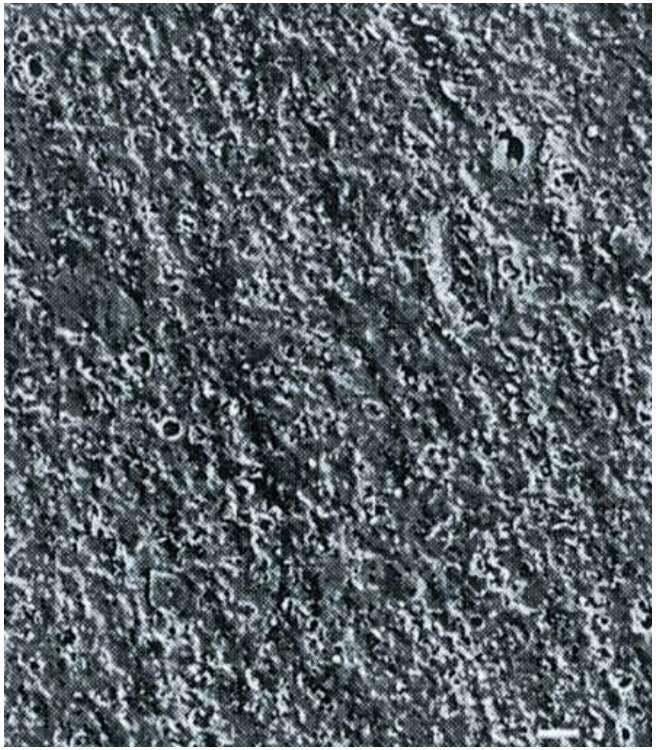
Microporous Film (MPF)

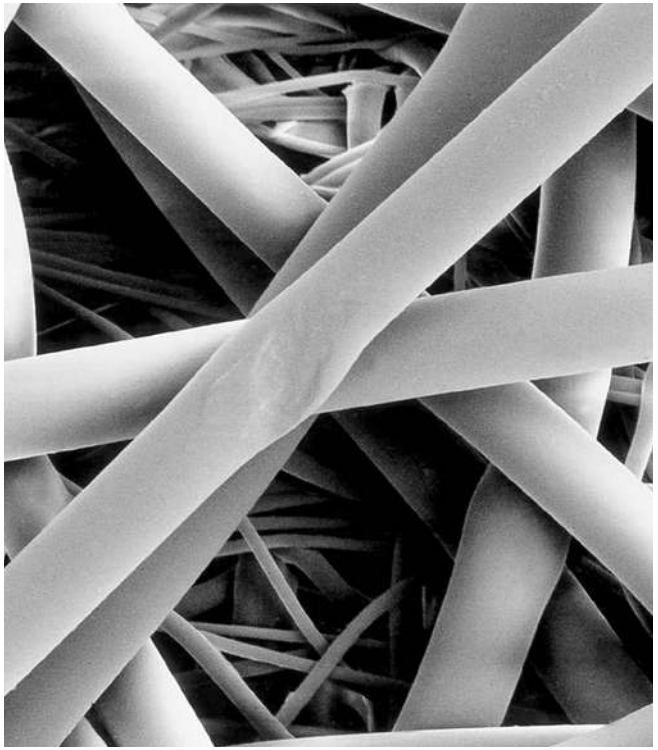
MPF fabrics are a bi-laminate material comprising a thin microporous film bonded to a spunbound polypropylene base. These fabrics offer limited durability since all barrier protection is lost when the protective film layer is abraded. In addition, their low air-permeability characteristics make then much less breathable than other fabrics with all this implies in terms of poor wearer-comfort and heat control.

Spunbound/Meltblown/Spunbound (SMS)

The performance of SMS fabrics relies on a meltblown polypropylene layer sandwiched between two open spunbound polypropylene layers. This inner polypropylene layer functions as the main filter for particles. However SMS fabrics tend to suffer from limited durability and relatively weak barrier performance due to their relatively open fibre structure. In addition, their high air permeability characteristics significantly compromise the barrier properties of the fabric making it only really appropriate for very basic protection and as a dirt barrier.







1:500 **Source:** DuPont.

Durability of SMS, MPF and Tyvek® fabrics

The figure illustrates fabric durability after 10 cycles of abrasion. At first glance SMS fabric remains unaffected but it has lower performance level. MPF protection barrier is impacted . The film gets abraded very easily and one can see that there are holes in the film. Only Tyvek® remains unaffected and has the highest protection level.

Linting

'Linting' refers to the tendency for some types of yarned and stapled fabric fibres to shed tiny particles into the atmosphere. This fibre displacement is greatly exacerbated when the fabrics are being moved or manipulated as is the case when working in a protective garment. In this case the lint that is shed can be a major source of contamination in applications ranging from paint spraying to cleanroom to hygiene-sensitive processes. On the other hand, fabrics manufactured from continuous synthetic filaments, such as Tyvek® have very low linting propensity and are suitable for medical, hygiene, paint and other particle-sensitive applications.

After 10 Cycles of abrasion

SMS



MICROPOROUS FILM (MPF)



DUPONT™ TYVEK®

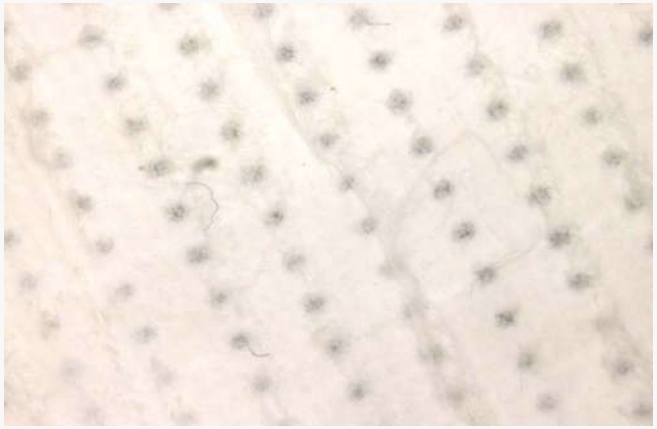


Figure 2 Abrasion: Simulation of wear and tear in everyday use,
Source: DuPont

APPENDIX 4

Fabric testing

Mandatory Tests

A CE marking signifies that chemical protective clothing meets certain minimum requirements (please see Appendix 1). However, it does not mean that chemical suits of the same Type offer the same level of protection performance. This is why it is essential to look at the results of the tests carried out on the material used to make the garment. As part of the CE requirements a number of mandatory fabric tests are required and, for each Type, these are classified from Class 1 (lowest) to Class 6 (highest). For further information please see Appendix 2.

The following are the mandatory tests for mechanical performance that must be carried out on a fabric:

Table 7 **Mandatory tests for mechanical performance.**

	Test method	Norm	Scope/Principle
Durability	Abrasion resistance	EN 530 Method 2	Abrasion is the physical destruction of fibers, yarns, fabrics resulting from the rubbing of the fabric suface over an abrasive glass paper. It ultimately affects the appearance of the fabric and results in the loss of performance properties after a number of cycles.
	Flex cracking resistance	EN ISO 7854 Method B	Flex cracking simulates repeated flex and folds in the fabric. The number of cycles to failure indicated by cracks and holes is recorded.
	Tear resistance	EN ISO 9073-3	Tear resistance determines the trapezoid tear resistance of a nonwovens by applying a continuously increasing extension in such a way that a tear propagates across the width.
	Tensile strength	EN ISO 13934-1	Tensile strength determines the maximum force and elongation at maximum force of the fabric using a strip method. The fabric is extended at a constant rate until it ruptures.
	Puncture resistance	EN 863	Puncture records the maximum force required to push a spike through the fabric with a constant rate until it perforates.
	Seam strength	EN ISO 13935-2	Seam strength determines the maximum force of seams when the force is applied perpendicularly to the seam which is extended until it ruptures.

Penetration vs Permeation

Penetration is the physical process whereby a liquid or solid passes through a material via "micropores", i.e. microscopic holes, in the fabric. It is especially relevant when referring to the particle penetration of a fabric or a whole suit. It is important to understand liquid penetration and repellency test data is generated during a 60 second test only. Consequently, it is only of value in the selection process to exclude those fabrics that allow chemicals to immediately penetrate. In order to assess whether a fabric protects the wearer against a specific chemical for durations exceeding 60 seconds, the permeation data must be consulted.

Permeation is the process by which a chemical, in the form of a liquid, vapour or gas, moves through protective clothing material at a molecular level and this 'molecular creep' can occur without any visible trace. This means it is possible for a liquid or vapour to permeate through a fabric even when there is no observed breaches or perforations in the fabric. The permeation process progresses in three steps: the substance is absorbed by the outside surface of the material; its molecules then diffuse through the material and finally the molecules desorb at the other surface (inside). The standard test duration for permeation is up to 8 hours or until permeation has been detected.

Notes:

Fabrics used in garments certified to Type 6 are typicallyonly tested for liquid penetration and repellency. This is why the scope of type 6 garments is intended for applications with "potential exposure to small quantities of fine spray/mist or accidental low volume splashes and where wearers are able to take timely adequate action in case of contamination". Therefore, it is preferable to verify the permeation data of the fabric even for Type 6 garments. Permeation and Penetration should not be confused. Many 'microporous' fabrics which can offer good liquid repellency characteristics, i.e. low penetration properties, exhibit high permeation rates which means liquids, in practice, will quickly permeate through.

Table 8 **Type 6 certified garments – tests.**

	Test method	Norm	Scope/Principle
Protection	Penetration by liquids	EN ISO 6530	Gutter test method determines indices of penetration, repellency and absorption by applying a fine stream of a test liquid to the surface of a clothing material resting in a inclined gutter.
	Permeation by liquids	EN ISO 6529 Method A	Permeation test method determines breakthrough detection time at normalized permeation rate and cumulative mass by analysing quantitatively the chemical concentration that has permeated after initial continuous contact with the chemical.
	Surface resistance	EN 1149-1	Antistatic test method is intended for materials used for electrostatic dissipative protective clothing to avoid incendiary discharge. A potential is applied to an electrode assembly rested on the fabric placed on an insulating base plate and the resistance of the fabric is recorded. The lower the resistance, the better the electrostatic dissipation.

Chemical Permeation Test

The Chemical permeation of a material is tested according to the European standard EN ISO 6529. The resistance of a protective clothing fabric to permeation by a potentially hazardous substance is described by the determination of breakthrough time using the permeation rate as a cut-off.

1. Sorption of molecules of liquid onto the contracted (outside) surface.
2. Diffusion of the sorbed molecules across.
3. Desorption of the molecules from the opposite (inside) surface.

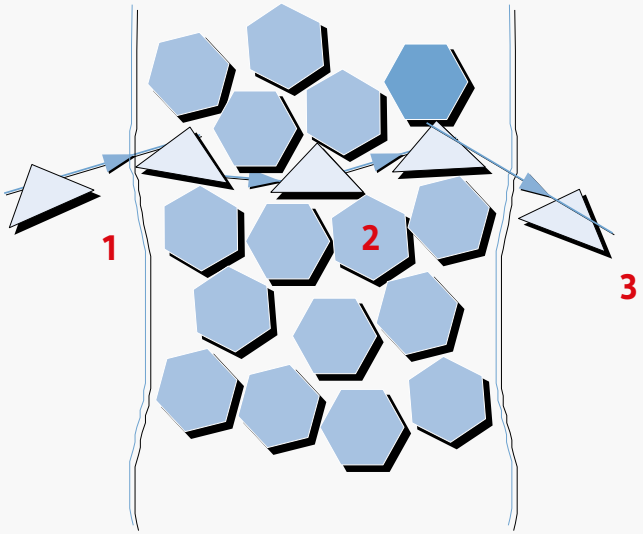


Figure 3 Permeation, **Source:** DuPont

The permeation test cell

The permeation test cell consists of two chambers that are separated by the fabric to be tested.The outside surface of the test fabric is exposed to the chamber containing the test medium (liquid or gaseous substance). Breakthrough of the substance is determined by measuring the concentration of the substance reaching the collection chamber per time unit.

Permeation rate

This is the speed at which the test substance permeates through the test fabric. Permeation rate is expressed as mass of the test substance (µg) flowing through the fabric area (cm^2) per time unit (min).

Steady State Permeation Rate (SSPR)

The SSPR is the level where the permeation rate reaches a maximum and continues at that. This is the state when all forces affecting permeation have reached equilibrium.

Minimum Detectable Permeation Rate (MDPR)

This is the minimum permeation rate that can be determined in the test. MDPR is a function of the sensitivity of the analytical measurement technique, the volume into which the permeated chemical is collected and the sampling time.

Minimum detectable permeation rates can be as low as 0.001 µg/cm^2/min in certain cases.

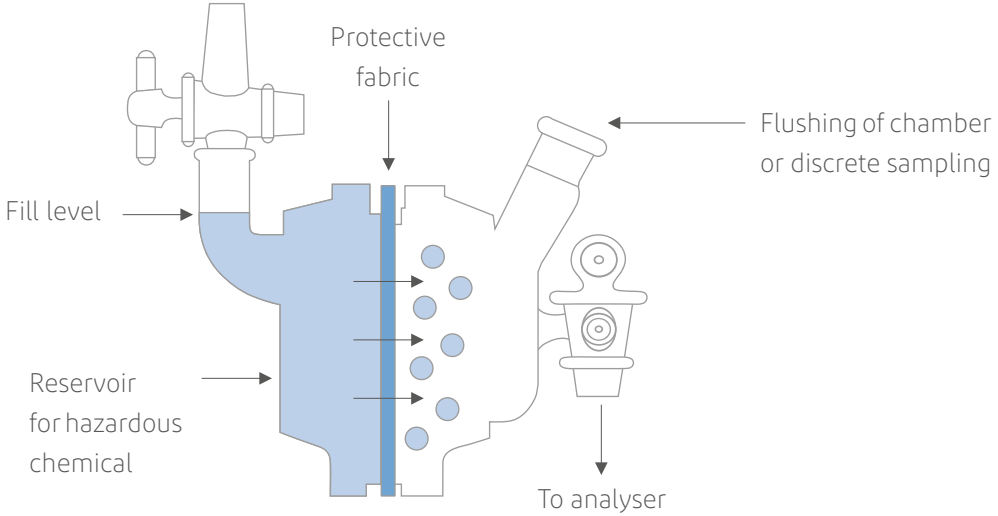


Figure 4 Permeation test cell, **Source:** DuPont

Barrier Breakthrough

The barrier or 'stopping' properties of a fabric are measured in terms of 'breakthrough time'; the time taken for a chemical or hazardous substance to penetrate completely through a fabric.

Normalised breakthrough time

The classification of permeation data – as defined by EN 14325[1] – is based upon the normalised breakthrough time measured according to EN ISO 6529[2] at 1.0 µg/cm²/min. Normalised breakthrough time is the average elapsed time between initial contact of the substance with the outer surface of the protective clothing material and the time at which the substance is detected at the inside surface at a defined permeation rate. The breakthrough time is 'normalised' as it is independent of the sensitivity of the measuring device. A normalised breakthrough time of >8 hours means that the average permeation rate has never reached the rate defined according to EN ISO 6529 (0.1 µg/cm²/min or 1.0 µg/cm²/min). However, the substance may have actually broken through.

Actual breakthrough

Actual breakthrough time is the average time elapsed between initial contact of the chemical or hazardous substance with the outer surface of the clothing material and the detection of the chemical on the inner surface by a measuring device. A permeation rate of 'ND' (not detected) does not necessarily mean that breakthrough cannot occur or has not occurred. It simply means that permeation was not detected after the test observation time of eight hours. Permeation may indeed have taken place, but at less than the minimum detectable permeation rate (MDPR) of the measuring device. MDPR can vary depending on the sensitivity of the analytical device for the given substance.

Notes:

Breakthrough time alone is not sufficient to determine how long a garment may be worn once it has been exposed to contamination. Safe user weartime may be longer or shorter than the breakthrough time depending on the permeation behaviour of the substance, its toxicity and the exposure conditions. In case of mixtures, permeation is measured for the most toxic substance since permeation cannot be measured for chemical mixtures. Account must be taken of the fact the permeation characteristics of mixtures can often deviate considerably from the behaviour of the individual chemicals. Furthermore, permeation rates are temperature dependent and typically increase with a temperature rise.

Table 9 **Normalized breakthrough time and EN Class.**

Normalized breakthrough time at a permeation rate of 1.0 µg/cm²/min in minutes	EN Class*
> 10	1
> 30	2
> 60	3
> 120	4
> 240	5
> 480	6

1 EN 14325:2004 - Protective clothing against chemicals. Test methods and performance classification of chemical protective clothing materials, seams, joins and assemblages.
2 EN ISO 6529:2013 - Protective clothing. Protection against chemicals. Determination of resistance of protective clothing materials to permeation by liquids and gases.
* EN 14325: Protective clothing against chemicals – test methods and performance classification of chemical protective clothing.

Liquid penetration and repellency test

The liquid penetration and repellency test is performed according to EN ISO 6530[1] (superseding EN 368) and is often referred to as the 'Gutter Test'.

Schematic of the test apparatus

In this test, the protective material to be tested is placed in an inclined gutter (45°) which is lined with an absorptive detector fabric. 10 ml of liquid is applied in 10 seconds onto the top of the test material via a syringe needle.

Penetration index

Any liquid which penetrates the fabric via the fabric pores within 1 minute is absorbed by the detector fabric and expressed as percentage of the original quantity and is a measure of the penetration of the fabric.

Repellency index

The amount of liquid collected in the beaker after 1 minute is expressed as percentage of the original quantity and is a measure of the repellency of the fabric. Note that EN ISO 6530 only requires four chemicals to be tested. Caution should be applied when interpreting penetration results since the test simulates exposure to small amounts of chemicals (10 ml) and short time (1 minute) only. Furthermore, for volatile chemicals it should be considered that some of the test substances would have evaporated during the test which can falsify the penetration data obtained. This is why EN ISO 6530 states that volatile substances (and their results) have to be identified as such. A protective clothing material with excellent results in the penetration test may give only poor protection when exposed to the same chemical in larger quantities and/or for extended time. To determine whether a protective clothing material with a low penetration index is really a protection against a specific liquid chemical, the chemical permeation data needs to be consulted.

Chemical mixtures

Permeation characteristics of a mixture of chemicals can often deviate considerably from the behaviour for the individual chemicals. If protection against a mixture of hazardous chemicals is required, we recommend you contact the manufacturer for expert advice.

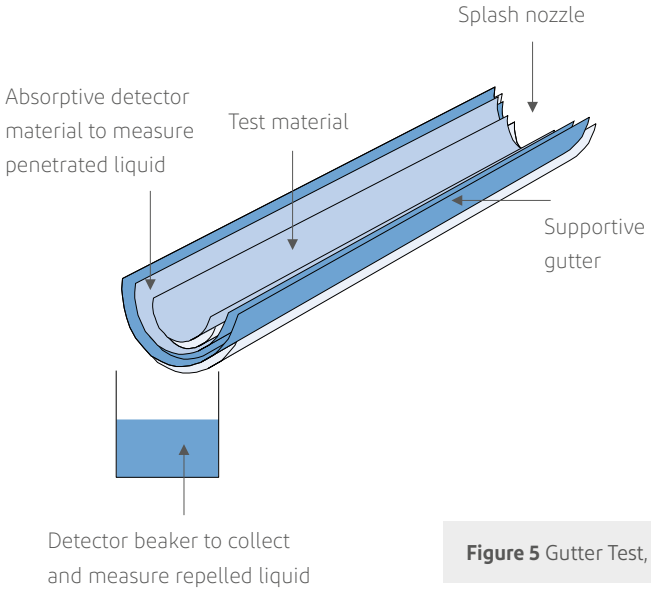


Figure 5 Gutter Test, **Source:** DuPont

No chemical permeation data for your chemical?

DuPont can facilitate the independent permeation testing of your specific chemical or chemical mixtures with the DuPont barrier fabrics.

[1]EN ISO 6530:2005 Protective clothing. Protection against liquid chemicals. Test method for resistance of materials to penetration by liquids.

The effects of abrasion

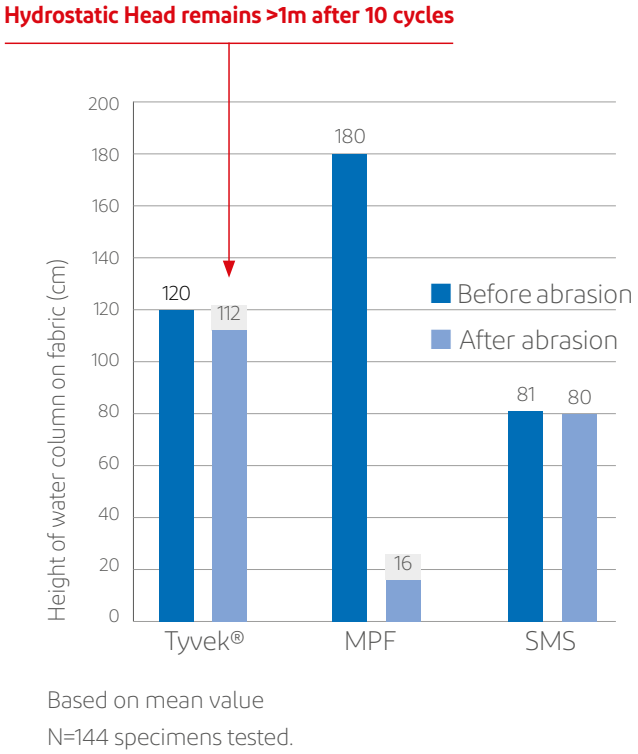
The effects of abrasion on a fabric's resistance to permeation and penetration

Fabric abrasion can seriously undermine the protective efficiency of a fabric. For example, fabrics that rely on thin coatings (please see Appendix 3) or have an inherently weak physical structure can quickly and easily lose their resistance to penetration under operating conditions. This loss of protection is particularly dangerous because in many cases the damage is not readily apparent or is not discovered until after an exposure occurrence. The susceptibility of some fabrics to a severe deterioration in penetration resistance following abrasion can be seen in the following hydrostatic pressure test. Hydrohead is an indicator for liquid barrier performance. It determines the resistance of a fabric to water penetration under slight pressure.

Prior to the abrasion test Microporous Film offers the best resistance to liquid pressure. But after just 10 cycles of abrasion, its performance takes a spectacular dive, while SMS is less affected but starts from a much lower performance level, and Tyvek® continues to protect. After abrasion, Tyvek® penetration performance is the highest.

The effects of abrasion on a fabric's resistance to permeation

The illustrations illustrate how the homogenous structure of a fabric such as Tyvek®, where the barrier properties are a function of the inherently tough material itself rather than a thin coating or layer, offer much superior and more reliable permeation resistance under under working conditions and over prolonged wear times compared to similar laminated products.



Based on mean value

N=144 specimens tested.

Figure 6 Liquid barrier performance. Hydrostatic Head: EN 20811. Before and after 10 cycles of abrasion (EN 530 - Method 2), **Source:** Independent Institute

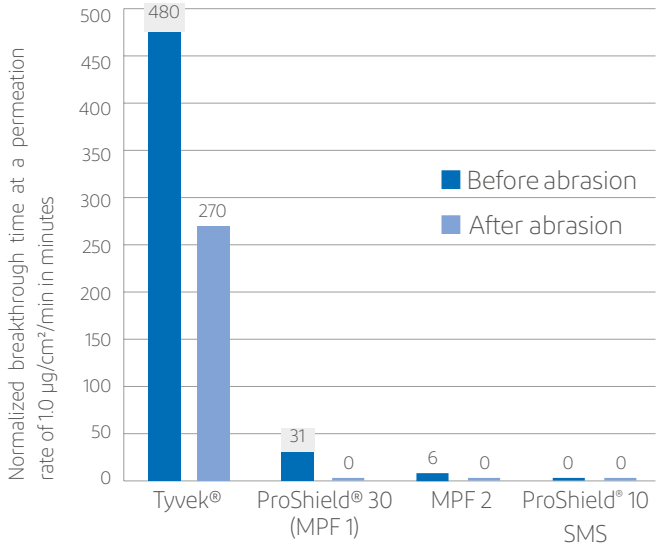


Figure 7 Permeation resistance to sulfuric acid 18%, **Source:** Independent Institute

Protective clothing against infective agents

Protective clothing against infective agents has to prevent infective agents from reaching the skin and to prevent the spreading of infective agents to other people and other situations, e.g. eating or drinking, when the person has taken his protective clothing off. The European Standard EN 14126 specifies requirements for clothing materials providing protection against infective agents. The test methods specified in this standard focus on the medium containing the micro-organism, such as liquid, aerosol or solid dust particles. EN 14126 comprises the following material tests:

Table 10 **Protection against infective agents (EN 14126) test methods.**

	Test method	Norm	Scope/Principle
Biobarrier	Resistance to penetration by blood and body fluids using synthetic blood	ISO 16603	The material is subjected to a body fluid simulant (synthetic blood) for a specified time and pressure sequence. A visual observation is made to determine when penetration occurs. The highest pressure with no visible penetration of synthetic blood is recorded.
	Resistance to penetration by blood-borne pathogens using Phi-X174 bacteriophage	ISO 16604	The material is subjected to a nutrient broth containing a virus for a specified time and pressure sequence. Visual detection is supplemented with an assay procedure that will detect viable viruses which penetrate the material even when the liquid penetration is not visible.
	Resistance to penetration by contaminated liquids	EN ISO 22610	The test method involves superimposing the bacterial contaminated donor (Staphylococcus aurus) material onto the fabric and subjecting it to mechanical rubbing. Due to the combined effect of rubbing and liquid migration, bacteria may spread from the donor material through the fabric down to the agar surface.
	Resistance to penetration by contaminated aerosols	ISO/DIS 22611	The test method exposes a material to a bacterium (Staphylococcus aurus) suspended in an aerosol and sprayed onto both an unshielded filter and one shielded with the test material. The ratio of bacteria found on the shielded (bacteria passed through) and unshielded (background bacterial count) filter is used to assess the barrier properties of the test material.
	Resistance to penetration by contaminated solid particles	ISO 22612	A portion of talc contaminated with Bacillus subtilis spores is poured on the fabric and captured on a sedimentation plate (Petri dish) after vibration for 30 minutes. After 24h incubation of the sedimentation plate, the number of colonies produced are counted.

Protective suits made of EN 14126 compliant fabrics must also meet the whole suit requirements specified in the relevant chemical protective clothing "Type" standard. They must be CE Certified as Category III and can be identified by the biohazard pictogram. The clothing Types to protect against biological agents are broken down as follows:

Table 11 **Protective clothing Types according to EN 14126:2003.**

Type	Description	Relevant standard
1a-B, 1b-B, 1c-B	Gas-tight	EN 943-1:2019, EN 943-2:2019
2-B	Non gas-tight	EN 943-1:2019, EN 943-2:2019
3-B	Protection against pressurised liquid chemicals	EN 14605:2005 +A1:2009
4-B	Protection against liquid aerosols (spray tight)	EN 14605:2005 +A1:2009
5-B	Protection against airborne solid particulates	EN ISO 13982-1:2004 +A1:2010
6-B	Limited protection against liquid chemicals (light spray)	EN 13034:2005 +A1:2009

DuPont Personal Protection offers protective suits which cover all four risk groups as well as Types 3 to 6. Depending on the form of biological agent, the levels of exposure, the nature of the work and the risk of infection, the barrier performance of the fabric to the relevant infective agent test(s) should be considered.

The type of seam and the material's mechanical robustness also needs to be taken into consideration. For instance, in the case of viruses, such as Ebola, performance with regard to their resistance to penetration by blood-borne pathogens (ISO 16604) is key.

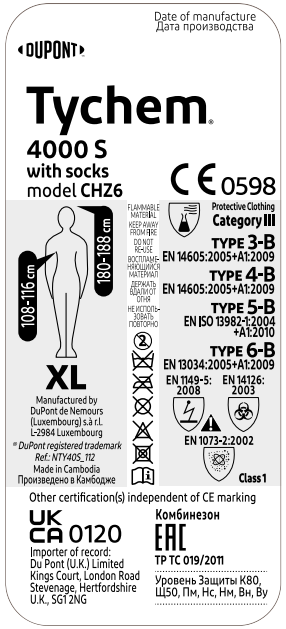
Whole garment performance

'A chain is no stronger than its weakest link' is a principlethat strongly applies to protective garments. A first class barrier fabric will be severely compromised if it forms part of a coverall with weak seams, unreliable closures and poor ergonomics. For this reason it is important that whole-garment tests are conducted to indicate protective performance and wearability in use.

The presence of a CE-mark on a coverall signifies that the garment complies with the safety requirements of the European PPE Directive /PPE Regulation (EU) 2016/425 and in the case of a Category III suit will include the registration number of the Notified Body, in the form 'CE- - - -', that certifies ongoing fulfilment.

CE

UK CA



Type Testing

In accordance with the EU CE requirements (please see Appendix 1), chemical protective (Category III) clothing is subdivided into six levels or 'Types' of protection (please see Appendix 2) each carrying a Type-test certificate relating to tests for different kinds and degrees of hazard exposure. In order to be certified as offering a particular 'Type' of protection, a fabric's physical and barrier properties must also meet minimum performance requirements (please see Appendix 3) and for Types 3, 4, 5 & 6, the whole suit itself must be tested to a minimum of one of the whole suit 'Type' tests and pass a dynamic movement test.

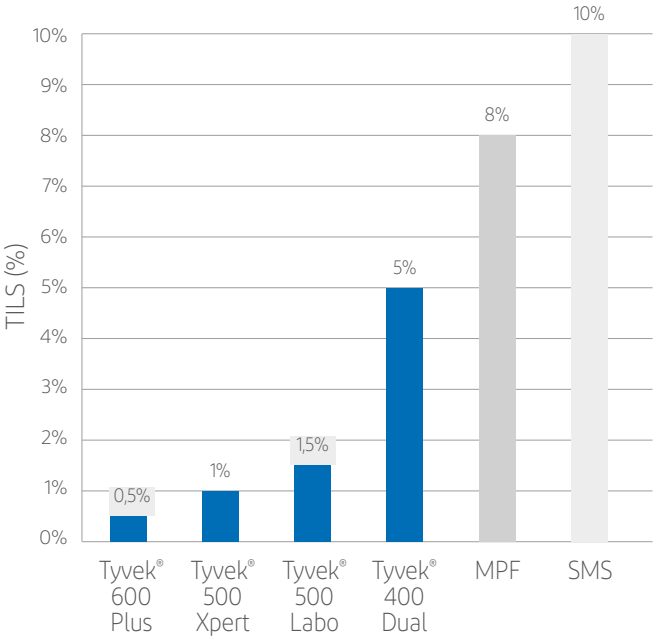
A word of caution

The EN whole-suit Type-tests (please see Appendix 3) define a maximum allowable amount of challenge test liquids, aerosols or particulates to ingress into the suit.

Example

For example, for the Type 5, 80% inward leakage average results must be lower than 15% of inward leakage. For the Type 6 low level spray test, penetrationspots at a maximum of 3 cm² of the test liquid are allowed on the undergarment.

In other words, allocation to a specific protection Type is not a sign that all protection suits of this type have the same barrier properties. Rather, protection offered by Type 5 suits can differ greatly in terms of the actual particulate barrier they provide, depending on the suit fabric, seam construction, design and whether the testing has been conducted with additional barriers, such as taping around the cuffs, ankles and hood/mask. Only by having a look at the detailed results can a user arrive at conclusions with respect to the actual barrier and impermeability properties of a given suit of a particular Type.



The suits were tested with a full face mask, boots and gloves taped at mask, cuffs, ankles and flap.

Figure 8 Total Inward Leakage (TILS): Average of the 10 suits and all activities EN ISO 13982 - (1 and 2).
Dry particles Sodium Chloride NaCl 0,6 µm,
Source: Independent Institute

Whole-suit Type Tests

For a abridged description of the conditions of the whole-suit Type tests please refer to Appendix 2 – The Relationship between Garment Categories, Types and Classes.

Radioactive particulate matter is dust and very fine particles which have been exposed to ionising nuclear radiation. Unless contained and managed these contaminated particulates not only present a serious health hazard to any personnel in proximity but, without proper safeguards, there is a further risk of radioactive particulates being inadvertently transferred elsewhere, for example to uncontained workplace areas. This is due to the ease with which microscopic radioactive particles can attach to clothing, footwear, tools and other items in the exposure zone and then be subsequently dispersed unknowingly into 'safe' environments.

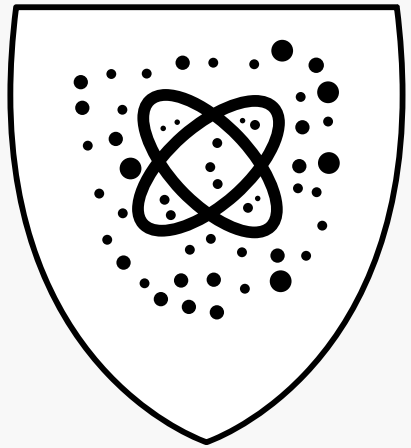
Standard EN 1073

The EN 1073-2 standard was developed for the nuclear industry and relates to the barrier properties of protective suits against contaminated solid particulates. It does not apply to protection from ionising radiation. The EN 1073-2 applies a recognised test method (EN ISO 13982-2) to determine the inwardleakage and the barrier efficiency of the garment when challenged under controlled conditions. Three levels of performance class are assigned to garments subjected to this test although the very broad performance spans of these three bands renders them, at best, a very blunt instrument for evaluatingthe relative performance of different garments. However the same EN test results can be expressed as a 'Nominal Protection Factor' (NPF) which assigns a specific numeric value to the protection provided. This makes it possible to compare suits within the same Class, for example to compare a suit that is at the very bottom of Class 2 with one at the very top of Class 2.

Class 1: Lowest particle barrier NPF 5 to 49.

Class 2: Intermediate particle barrier NPF 50 to 499.

Class 3: Highest particle barrier NPF >500.

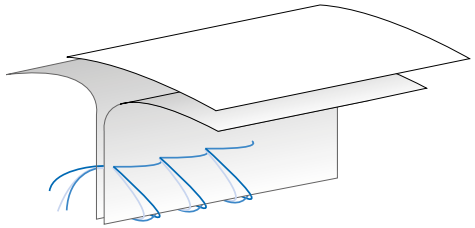


Seam construction and performance

Garment seam design and quality is a very important consideration. All protective garments employ seams in their construction and due attention must be devoted to ensuring that the seam technology employed is up to requisite standard. It is not enough for a garment to be manufactured using the best barrier fabric if the seams are weak or leak. Different seaming configurations and connection systems are available which provide the necessary strength and impenetrability for different hazard and usage situations. The same considerations apply to closure systems such as zips and storm flaps, and to garment interfaces and boundaries in the neck, hood, wrist and ankle areas.

All Category III chemical protective clothing must undergo a seam strength test as well as the relevant "whole suit" inward leakage test. Tight, reliable seams are an absolutely critical element in the overall barrier protection performance of a garment therefore when selecting a garment, it is important to verify the seam performance in addition to the fabric performance. Just because a seam is tight doesn't mean that it is impermeable and vice versa. Stitched seams on their own, for example, are never so fully tight that gas or particulates cannot penetrate. By properly overtaping a stitched seam, however. it can be made as tight and strong as the parent fabric material.

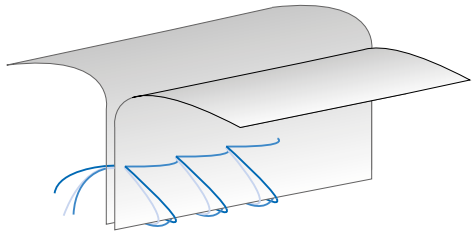
Type 3/4



Stitched & Overtaped seams

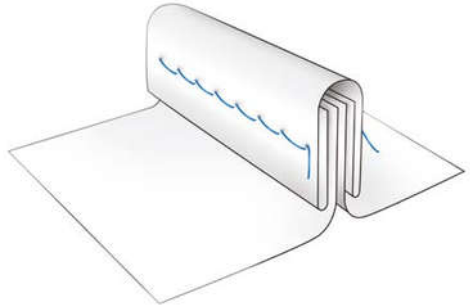
Seams can be stitched and overtaped. The tapes used for DuPont products with this type of seam offer a barrier equal to that of the fabrics.

Type 5/6



Stitched seams

Stitching offers good balance between seam strength and seam barrier.



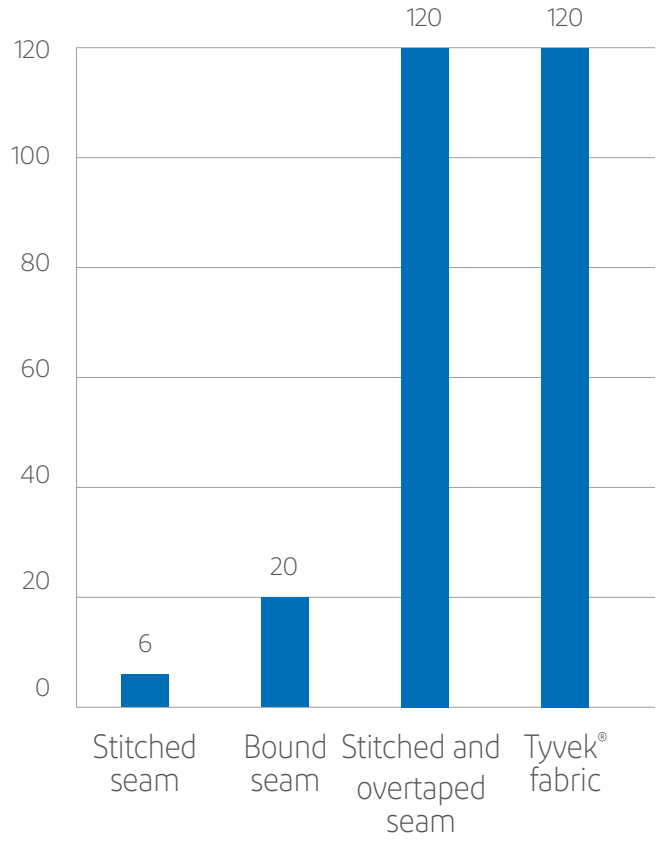
Bound seams

Seam construction leaves the needle holes visible. Construction is unlikely to offer permeation barrier equal to the fabric.

Figure 9 Three types of seam construction, **Source:** DuPont

Pressurised exposure resistance

Hydrohead is an indicator for pressurised exposure resistance. The test is based on water column test, stichted and overtaped seams are tight and offer the same barrier as the fabric itself.

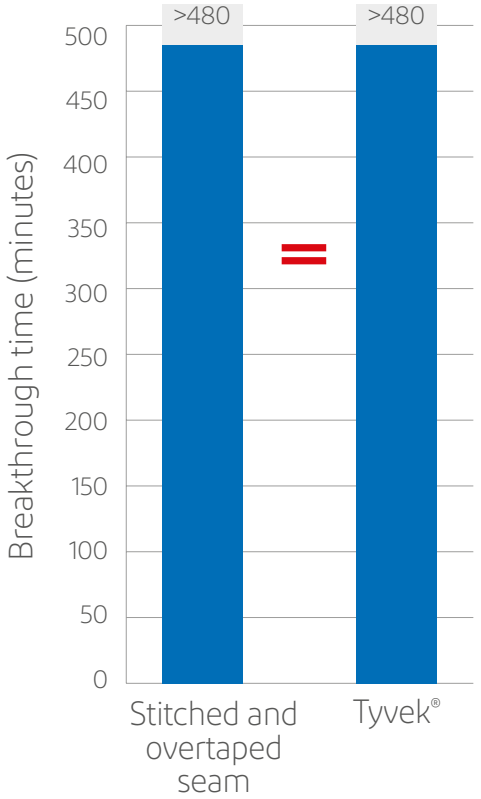


N=16 specimens tested

Figure 10 Pressurized exposure resistance. Hydrohead DIN EN 20811 (centimeters of H2O), **Source:** DuPont

Permeation results

Based on permeation test, stitched and overtaped seams are tight and offer the same barrier as fabric.



N=16 specimens tested

Figure 11 Permeation EN ISO 6529 with Sulfuric acid 18% (BT 1.0 normalized breakthrough time at 1.0 µg/cm²/min.), **Source:** Independent laboratory

APPENDIX 6

Comfort considerations

Key comfort factors

Comfort is a somewhat subjective and personal matter but some key comfort factors frequently cited in wearer trials include:

- Garment design: ample freedom of movement when bending/stretching.
- Breathability: ability of the garment to allow sweat to evaporate and provide moisture vapour permeability.
- Feel on the skin, softness. Garment weight.
- Wearing undergarments such as cotton that absorb sweat improves the "feel" on the skin.
- Wearing long-legged and long-sleeved undergarments.

Garments with air and moisture vapour permeability will be more comfortable than non-breathable materials and coated fabrics but this is usually at the expense of particulate or chemical barrier properties.

The need for comfort

When it comes to day-in day-out health and safety compliance, operator comfort is one of the key 'human factors' that govern the correct use of personal protective equipment (PPE). The importance of wear comfort and correct garment fitting cannot be overstated. A large proportion of observed PPE non-compliance occurrences are not due to an absence of protection but are simply due to workers avoiding, misusing or abusing the protection provided. And even where staff are wearing the appropriate equipment, if it doesn't fit or if it isn't comfortable then it is often being worn incorrectly[1].

Discomforting costs

While providing necessary protection to the user, the wearing of PPE (personal protective equipment) invariably creates an impediment to worker performance, communications and comfort. In some cases the provision of personal protection comes at a high cost in terms of operator comfort and efficiency and, unless carefully managed, these are conflicts that can lead to field operators being exposed to further risks and for a tendency for otherwise effective workwear to be shunned, used incorrectly, or unofficially modified.

Finding the optimum balance

PPE misuse may just be just down to a momentary lapse of attention but that's all it takes for yet another casualty to be added to the workplace accident statistics. Fatigue, restricted movement, reduced dexterity, impeded vision, low tactile sensitivity and even annoying fabric rustle, are just some of the reasons that cause workers to shun, abandon or misuse protective equipment. The secret rests in finding the optimum balance between comfort and protection, between safety and productivity, between fit and functionality.

High performance PPE ensembles, while providing effective chemical protection, can serve to introduce new risks relating to physiological and psychological stresses. For example the life-threatening dangers of hyperthermia (heat stress) from unventilated protective garments are well documented. Similarly, the psychological impacts associated with wearing constrictive, bulky and sometimes claustrophobic worksuits are perhaps less well documented but every bit as real. Anything which can negatively affect the judgement of an operative in a highly dangerous, highly stressful environment must be taken very seriously.

[1] Health and Safety Laboratory for the Health and Safety Executive, Human factors that lead to non-compliance with standard operating procedures, 2012.

Size matters

Comfort, safety and productivity are partly a function of garment size and fit. A full range of coverall sizes is absolute necessity since there is a clear correlation between fit and function when it comes to protective coveralls. For example, by comparison, a single size of footwear or gloves cannot be expected to fit an entire workforce. Garments that are either too big or too small introduce unnecessary risks. Loose, non-breathable fabrics will contribute to a 'bellows effect' potentially causing unwanted air exchanges between the worker and his/her surrounding environment and will be easy to snag, awkward to wear and potentially restrict the wearer's vision. On the other hand, tight body-hugging coveralls will tend to expose the body's extremities, will be dangerously stressed during bending and stretching movements, will significantly impede movement and be very uncomfortable to wear.

Garment cut

Be aware that low-cost coveralls will often skimp on the cut to reduce fabric usage and this can have unacceptable consequences. Over-tight garments will pinch and pull, the fabric will be unduly stressed, they will be uncomfortable to wear, they might restrict movement and the seams can be stretched and break or open up and lose their efficacy. It is not only comfort and efficiency that is at stake, the worker's health and safety will be unnecessarily put on the line.

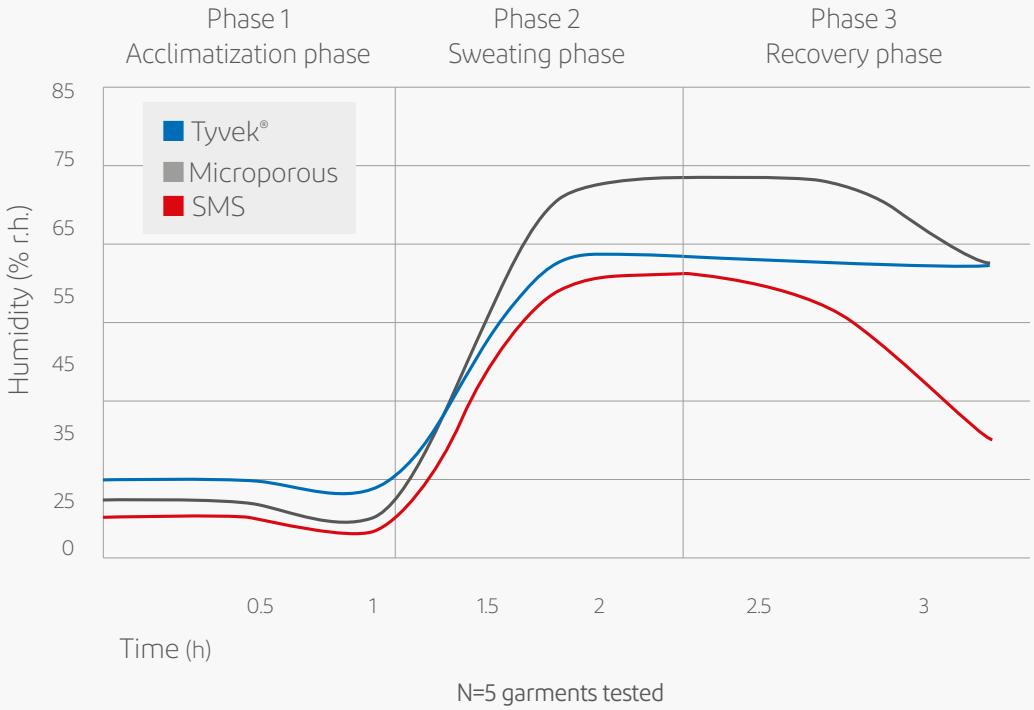
The Tyvek® barrier fabric from DuPont uses a proprietary non-woven fabric structure to provide a protective fabric that actually allows moisture vapour to pass through.

The material is formed from High Density Polyethylene (HDPE), with diameters as low as 1/150th of a human hair, which are spunbonded into a tough, light, homogeneous fabric with inherent vapour breatheability characteristics on account of its microscopic lattice structure.

This inherent ability to evacuate body moisture results in greatly improved wearer comfort in many Type 4,5 and 6 applications.

Humidity between underwear and garment

With their open structure, SMS coverall removes better the humidity than Microporous Film, by far. Tyvek® meets quite good performances during sweating. Microporous Film is the material that takes the longest time to remove humidity.



N=5 garments tested

Figure 12 Humidity between underwear and garment (by family)
Source: Independent Institute

APPENDIX 7

Static electricity discharge

The electrostatic properties of protective clothing

The rubbing of a synthetic material against the skin or undergarments is sufficient to permit electrostatic charges to build up on the fabric. These triboelectric effects of a fabric can generate thousands of volts and a charge dissipation via a tiny spark from a coverall to a surface of opposite electrical potential in a flammable, gaseous, or dust-charged atmosphere could result in a catastrophic explosion.

Safety in explosive environments

Companies operating in sectors such as the chemical, pharmaceutical, industrial coatings and gas supply industries use combustible materials that can potentially create explosive atmospheres.

These 'explosive protection zones' or 'EX-Zones' are classified into various categories depending on the frequency and length of time that the hazard exists.

Combustible gases and vapours are classified into three explosion groups (IIA, IIB and IIC) according to the minimum amount of energy required to ignite them. The most easily ignitable group is class IIC.

Antistatic features in protective clothing

Antistatic finishes for limited-use garments generally work by using the moisture of the air to turn the finishing-compound into a charge-conductive surface. This means, that if there is enough moisture in the air – typically above 25% RH – the antistatic property is 'active'. If however the moisture level is below 25% RH, the antistatic property will be either reduced or perhaps completely absent, depending on the prevailing humidity level.

Table 12 Categories of Ex-Zones.

Ex protective Zones for gases, vapours and mists		Ex protective Zones for dust	
Zone 0	A place in which an explosive atmosphere consisting of a mixture with air of dangerous substances in the form of gas, vapour or mist is present continuously or for long periods or frequently.	**Zone 20**	A place in which an explosive atmosphere in the form of a cloud of combustible dust in air is present continuously, or for long periods or frequently.
Zone 1	A place in which an explosive atmosphere consisting of a mixture with air of dangerous substances in the form of gas, vapour or mist is likely to occur in normal operation occasionally.	**Zone 21**	A place in which an explosive atmosphere in the form of a cloud of combustible dust in air is likely to occur in normal operation occasionally.
Zone 2	A place in which an explosive atmosphere consisting of a mixture with air of dangerous substances in the form of gas, vapour or mist is not likely to occur in normal operation but, if it does occur, will persist for a short period only.	**Zone 22**	A place in which an explosive atmosphere in the form of a cloud of combustible dust in air is not likely to occur in normal operation but, if it does occur, will persist for a short period only.

Source: Directive 99/92/EC

Table 13 Examples of explosion groups.

IIA	IIB	IIC
Acetone Benzene Toulene	Ethylene Ethylene oxide Diethyl ether	Acetylene Hydrogen Carbon disulphide

Source: TRBS 2153 – Technische Regel für Betriebssicherheit, Vermeidung von Zündgefahren infolge elektrostatischer Aufladungen – www.baua.de

Earthing

In order to avoid the creation of sparks (that might ignite an explosive atmosphere or cause operator discomfort), the garment and the wearer need to be properly grounded. This means that both the clothing and the wearer must be continuously earthed, taking care to ensure that the correct fabric side (inner or outer) is grounded in those cases where the garment's antistatic treatment is limited to one side. Special attention must also be paid to garments with attached socks or overshoes.

There are some essential rules for the safe discharge of static electricity:

- Both wearer and garments must be correctly and continuously grounded via conductive safety shoes, floor and/or grounding cable.
- Electrostatic charges may build up on ancillary equipment. Breathing apparatus and other devices must therefore be separately grounded when being worn in conjunction with a garment.

Single-sided versus double-sided

Some fabrics, particularly multi-layer, coated and coloured fabrics, may be antistatic treated on one side of the material only. An antistatic coating on both sides of a garment will reduce antistatic build-up and the attraction of particulates. However, neither single- or double-sided coatings will necessarily preventthe risk of ignition in highly explosive conditions such as hydrogen atmospheres and oxygen-enriched air. In these cases the garment manufacturer must be consulted for guidance. In all situations the garment must be adequately grounded. With one-side treated garments care must be taken to ensure that it is the surface of the clothing which has been given antistatic treatment that is earthed.

Atex Directives

For standard chemical protective clothing it is not a compulsory requirement for garments to be antistatically treated or have antistatic features. However due to the prevalence of operations and applications being managed under ATEX controls it is a much-requested feature.

Organizations in the EU must follow the ATEX[1] Directives to protect employees from explosion risk in areas with an explosive atmosphere.

There are two ATEX directives:

- The new ATEX Directive 2014/34/EU[2] is for equipment manufacturers and covers equipment and protective systems intended for use in potentially explosive atmosphere.
- The 'ATEX 137' workplace directive 99/92/EC[3] provides minimum requirements for improving the safety and health protection of workers potentially at risk from explosive atmospheres.

Antistatic certifications

In order to compare antistatic properties of chemical protective clothing on a standardised level, there are several norms which manufacturers can use. With such norms the surface resistance and the charge-decay properties of fabrics can be measured and/or assessed. The surface resistance is covered by EN 1149-1 and the charge-decay is covered by EN 1149-3. EN 1149-1 is mostly used for finished fabrics, whereas EN 1149-3 is used when surface resistivity can not be used because the dissipation of charges is based on induction.

In addition to these test-method standards there is a further standard, EN 1149-5:2018[4] which provides the performance requirements for anti-static PPE.

Notes:

For the antistatic performance data relating to a particular product please refer to the relevant technical data.

1 ATEX - The abbreviation derives from 'ATmosphères EXplosibles'.
2 Directive 2014/34/EU on equipment and protective systems intended for use in potentially explosive atmospheres.
3 Directive 99/92/EC Minimum requirements for improving the safety and health protection of workers potentially at risk from explosive atmospheres.
4 EN 1149 - 5:2008 Protective clothing with electrostatic properties.

APPENDIX 8

Garment donning, doffing and adjustment

The right size and usage of the garment

Choosing the correct size of garment is a prerequisite not just for greater safety but also for greater comfort. Choosing the wrong size can have fatal consequences; if it's too big it can get stuck in production machinery, if it's too small it can tear or considerably restrict mobility. It is important that a coverall is used that not only offers the correct protection but also fits the person properly.

For guidance on donning and doffing procedures please consult your supplier refer to the following videos.

Tyvek® 500 Xpert

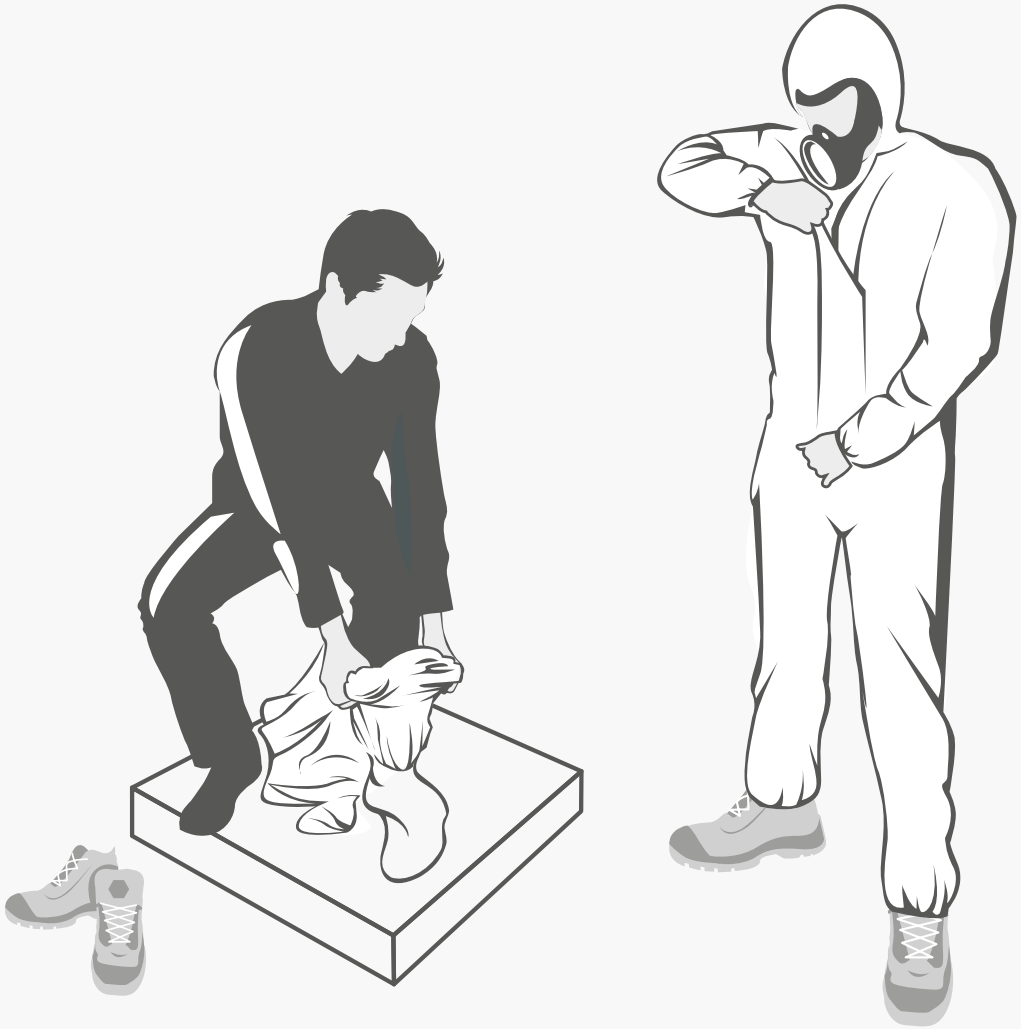
Tyvek® 800 J

Tychem® 6000 F

Tychem® 6000 F FaceSeal

Training

A theoretical knowledge of how to don and doff a protective garment is no substitute for practice. It is important to remember that only people who have received specific training should be authorised to wear, remove and dispose of contaminated clothing.



APPENDIX 9

Garment storage and expected life span

Good storage and maintenance will ensure that a protective garment performs as it should do at the time it is needed. Correct storage is an essential part of any PPE programme, whether the items are used being used daily or stored for future or emergency use. Inadequate or unduly prolonged storage conditions can directly affect a product's functional performance and provisions must always be made to ensure that adequate storage and renewal provisions are in place.

Garment 'Shelf Life'

The 'shelf life' of a protective garment relates to it expected functional life under recommended storage conditions. It is the timespan during which a product can be used with its functional performance still intact. Different products and brands can have widely varying 'shelf lives' with some having a very limited shelf-life and others coming from suppliers that are unable to provide accurate product longevity data. This is very important, since a product with an expired shelf-life cannot be guaranteed to provide the level of wearer safety specified and their use could leave personnel with inadequate protection.

There is no official norm describing how shelf life of PPE should be determined and therefore specifiers and users must ALWAYS CHECK what manufacturer tests have been conducted and what data is available to support claims relating to product life expectancy.

Garment storage and maintenance

Both garments in storage and garments in use must be stored correctly in accordance with manufacturer's recommendations. Typically this will require that they are kept in clean, dry, secure conditions at temperatures of between 10-25°C preferably in a dedicated and sealed container or locker to minimise the risks of tampering, unauthorised use, and inadvertent damage. Direct exposure to sunlight for prolonged periods must be avoided and garments must always be visually inspected for damage before wearing.

It is recommended that a nominated person is put in charge of storage and maintenance to ensure that the responsibility is not overlooked or carried our ineffectively. Employees should be educated in the correct use of all PPE and must be responsible for reporting any loss, fault or damage.

It is the employers responsibility to ensure that appropriate PPE is available at all times to employees. It is important that a PPE review, rotation and replacement programme is in place to check that protection is available and that it is within its designated shelf-life.

In the case of Tyvek® and Tychem® products, DuPont has based its recommendations for operational shelf life upon accelerated-ageing tests on fabric tensile properties. Different fabrics were aged using an ASTM 572-88 test modified to incorporate higher temperatures (100°C vs 70°C) and higher pressures (300 psi vs 100 psi), to provide a more rigorous evaluation. The results of this evaluation conclude that Tyvek® and Tychem® fabrics retain physical strength and barrier properties over following years:

Fabric Type	Expected fabric shelf life (years)
Tyvek®	10
Tyvek® 800 J	5
Tychem® 2000 C	10
Tychem® 6000 F	10
Tychem® TK	10
Tychem® 4000 S	5
ProShield® 20	3
ProShield® 60	3
ProShield® 20 SFR	1,5

Periodic garment testing

In the case of gas-tight suits it is recommended that regular pressure tests are carried out on at least annual intervals throughout the designated product life span. This applies whether the products are in use or in storage.

APPENDIX 10

Garment disposal and end-of-life options

Disposal and Recycling

For environmental and safety reasons it is important that users of protective clothing have a garment disposal and recycling programme in place. Many types of uncontaminated and unused garments can be recycled at standard recycling facilities. Contaminated coveralls should be treated as hazardous waste and be disposed of according to the nature of contamination and in accordance with national and local regulations. This will normally entail incineration or other approved method.

Tyvek® is a nonvowen sheet made of 100% High Density Polyethylene (HDPE). It is produced by DuPont de Nemours Luxembourg S.à r.l. Under an environmental policy verified to ISO 14001. DuPont is comitted to the efficient utilisation of reutilisation of resources and collaborates with designers, converters, manufacturers and others to help them meet their sustainability goals.

Notes:

For safety reasons DuPont does not recommend the use of reuseable and launderable garments where a limited-use garment of equivalent or higher-performance is available.

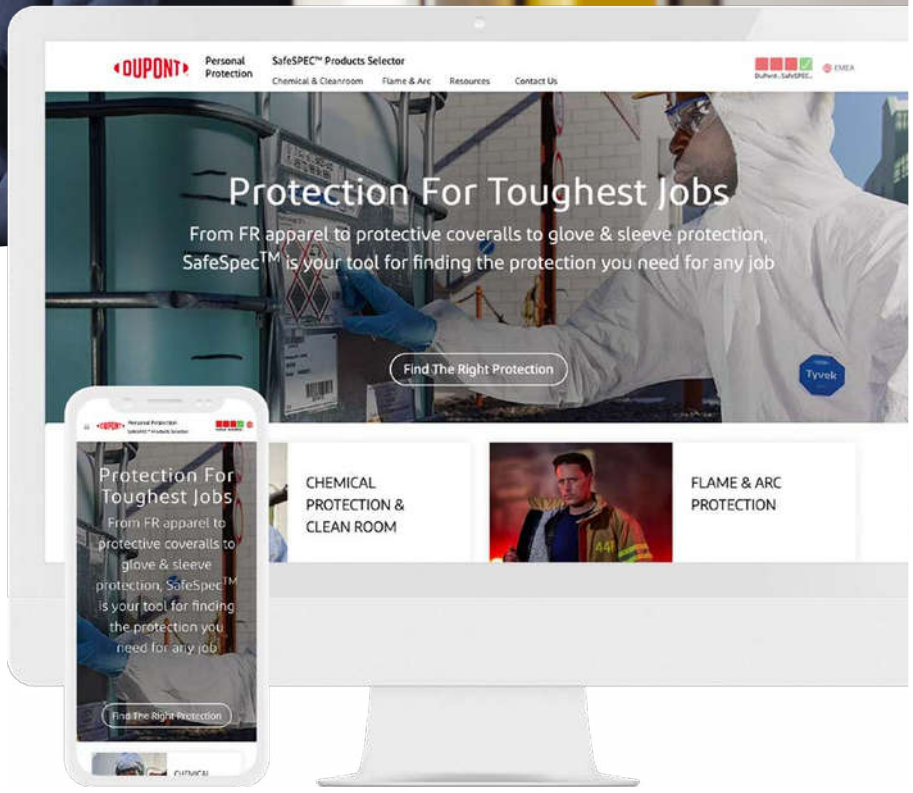
Most preferred option

1. Virgin, unpigmented Tyvek® can be 100% recycled back into equivalent quality product with no loss of properties or functionality whatsoever. DuPont has been carrying out this recycling process at its manufacturing plants for several decades.
2. Using the right preparatory and processing equipment, used but uncontaminated Tyvek® can also be recycled at facilities accepting grade 2 HDPE. Reclaimed material can be repurposed into new quality products such as garden furniture, milk crates, wall cladding, toys, refuse containers and waste pipes.
3. Subject to local regulations, contaminated Tyvek® can be safely incinerated and, under optimal conditions, will only release water and carbon dioxide, leaving no significant residues. It can be used a fuel yielding more than twice the energy value of coal , and as much energy as oil, in terms of BTU rating.
4. If recycling or incineration are not options, Tyvek® can be safely landfilled. Because it is chemically inert and contains no fillers, binders or additives, Tyvek® will not leach into groundwater nor release contaminants into the soil.

Least preferred option

Figure 13 End-of-life options for Tyvek® products, **Source:** DuPont





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