Techie Fibres

What makes good PPE?

PPE is critical for the protection of workers in a variety of different professions and industries – but in order to do its job it has to be specified correctly and looked after properly, throughout its life.

The UK's Textile Services Association (TSA) is the trade body representing commercial laundries and textile suppliers. Many of its members have specialist expertise in PPE, supplying, managing and maintaining protective workwear for a variety of industries and the healthcare sector. Here Shyju Skariah, Director of Programmes and Projects at the TSA, considers the issues.

These days there is a huge variety of personal protective equipment (PPE) available in industry and healthcare to protect workers and the public. From hi-vis jackets for civil engineers, to garments designed to guard against hazardous chemicals in factories, to PPE to protect doctors and patients in healthcare, each has its own application and is manufactured specifically to meet that need. Typically these garments are constructed from fabrics which are formed by blending multiple fibres of natural or synthetic origin, which are then treated with chemicals by surface spraying, immersion or penetrative procedures to provide maximum protection and to enhance long-life functionality.

Getting your head around the manufacture of these garments is almost impossible. The world of fibres is hugely complex in itself, let alone the processes involved in the manufacturing of fabrics, the garment construction and the subsequent specialist treatments!

The fabrics undergo a plethora of processes to make them into the PPE workwear that you and I would recognise in our daily lives. These processes may include:

- *Colour dying*
- *Surface spraying*
- *Immersion and high-pressure penetration*
- *Drying process*
- *Rolling or folding*

Clearly, quality control is critical at all stages of the manufacture of PPE garments. The fibre and fabrics manufacturing processes are often done offshore which makes it ▸

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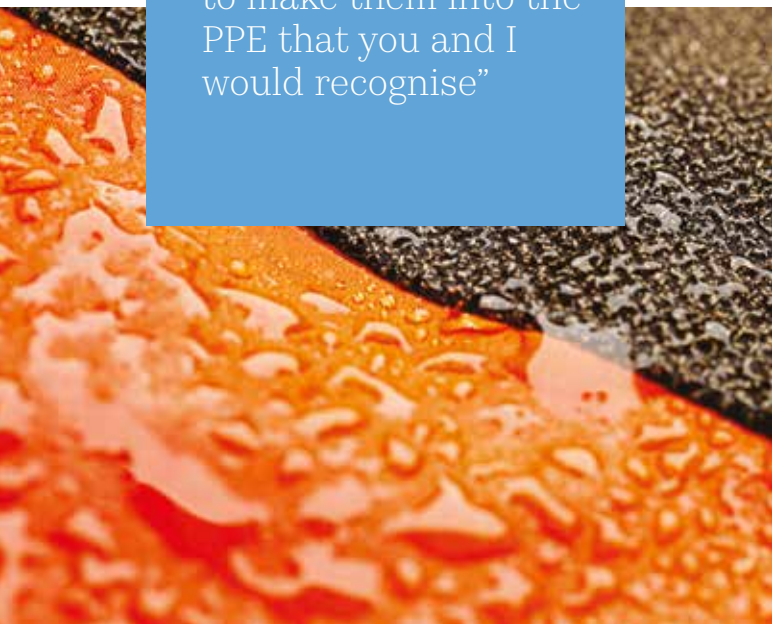

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difficult to rectify any errors once the garment construction is in progress in the UK or mainland Europe. These processes are critically important to ensure that they are quality controlled and managed well. Final drying, storage and transport procedures are also key to ensuring that the fabric arrives in sound condition. There are a number of standardised tests that the garment manufacturer will conduct to validate the fabric performance.

Once the garment is constructed, it must conform to all the relevant performance standards, be fit for purpose and, most importantly, conform to the regulation sizing specifications. These vary for a variety of reasons, such as whether the wearer will be male or female, and the destination country's own standards.

Where the buck stops...

Responsibility for the performance of the garment rests wholly with the owner of the garment. The wearer may be an employee, whether a surgeon, an engineer, a fire-fighter, or whatever, and, at any time, their safety could depend on the performance of the garment. That's why the maintenance of PPE should always remain with the owner. If the wearer is allowed to take the garment home to wash and dry, the specific controlled maintenance of the garment is lost and damage may result from incorrect laundering. Equally, washing soiled workwear at home could adversely impact the cleanliness and hygiene of the domestic laundry and could even damage the domestic washing machine.

The garment manufacturer must provide washing and drying instructions. It's essential that these are followed exactly, or the performance guarantee will be rendered invalid. Incorrect laundering could cause shrinkage, colour loss, treatment damage and reduced longevity. Worse, it could result in the wearer's safety being compromised.

PPE in industry

The types of PPE workwear used in the industry include garments to protect from chemicals, arc flash, and electrostatic discharge. In the food processing industry, PPE is designed to protect both the user and the products being made.

Chemical-resistant garments

These offer protection against spills and splashes in low-risk environments. The most commonly specified chemical-resistant garments are Type 6 PB – the definition of Type 6 is 'limited protection against chemicals.' These garments are reusable as they are made from a breathable textile, which in turn can be industrially laundered. All fabrics used for the manufacture of such garments are treated with a liquid-repellent finish, delivering chemical splash protective properties. This is achieved by applying a Fluorocarbon (FC) finish to the fabric before the manufacturing of the garment. It's essential that the user returns their garments to be reactivated and, when needed, re-impregnated with the liquid-repellent finish. Fluorocarbon retreatment is highly effective, however, due to the concerns around the persistence of PFAS (Perfluoroalkyl and Polyfluoroalkyl Substances) in the environment, the industry is switching to alternative retreatment processes or making use of inherently flame-resistant fabrics. ▸

Selecting the right garments is critical. The specification comes from a range of factors including:

- *The chemicals being used and their hazards*
- *Whether contact with chemicals is a result of occasional splashing or is more continuous*
- *The length of time the worker will be wearing the protective clothing*
- *The parts of the body that the chemical could potentially contact*

Arc Flash Protection

An electric arc discharge is the spark that jumps between any gap created in an electrical system. Such highly powerful flash events happen every day in UK workplaces around power lines, generators and other electrical equipment. PPE garments need to be specified and properly maintained to ensure that people who are exposed to such risks are protected. Moreover, the specific level of risk should be assessed to allow the appropriate arc flash protective garments to be specified. The correct Arc Flash garments provide significant protection from these highly dangerous events. The main industries that use such garments are power generation, utilities, petrochemicals, rail and industrial electrical.

PPE for Electrostatic Discharge (ESD)

ESD has the potential to fatally hurt someone within microseconds. There are work environments where there is a high risk of hazardous sparks caused by an electrostatic discharge that could result in fire and/or explosion. Garments with anti-static properties are there to reduce the build-up of ESD. Anti-static clothing will always be teamed up with fire retardant properties, either inherent or as a flame-resistant finish, to protect the wearer against heat and flame caused by a static build-up.

Electrostatic Discharge (ESD) is also a known cause of damage to sensitive electronic components during manufacture. ESD garments transport static away from the body, reducing the build-up and eliminating the shock effect.

ESD garments are also used where the shedding of lint can affect the function and/or the appearance of a product. For example, low-linting fabrics are used in the paint and coating industries to eliminate lint falling onto smooth clean finishes. This clothing will predominantly be a synthetic fabric as this offers low linting properties. These garments use Nega-Stat technology, a permanent encapsulated conductive carbon yarn that is woven into the fabric which dissipates the static. If you look closely at some of these fabrics, you could see a black grid, which is the Nega-Stat technology.

Molten metal

There are other PPE garments that protect the wearer against a range of hazards. These products are designed as coveralls, jackets and trousers, are highly visible and are flame and heat-retardant. They can, for example, be used whilst welding or working with molten metal. All these products need to go through stringent testing through standards including EN 1149, EN 20471, EN 11611, EN 11612, EN 13034, and EN 61482.

The food processing industry

PPE used in the food processing sector form an important part of the protection for both the wearer and the products. The garments include coveralls, jackets, trousers and aprons, usually made with a minimum of 245 gsm polyester/cotton fabric. A variety of sectors ▸

within the food industry use these products, including manufacturers, abattoirs, food preparers, culinary schools and supermarkets. They are required to maintain their PPE products to high standards, using the correct care processes.

PPE in healthcare

Healthcare is critically important to any community. In the UK, we pride ourselves on our National Health Service and the technological advancements in medical care have made the NHS an enviable mechanism for large-scale healthcare provisions. Specialised textiles play a central role in all our hospitals and surgeries, especially surgical textiles, ward garments, healthcare PPE and uniforms. When it comes to surgical textiles and PPEs, BS EN 13795 is the go-to document for the quality management of these products. This standard contains references to a suite of test methods that allow for stringent testing including:

- *High mechanical resistance, through testing burst resistance (ISO 13938-1)*
- *Tensile strength (EN 29073-3)*
- *Being able to resist liquid penetration (ISO 811) which is essential for preventing infections through exposure to any bodily fluids*
- *Microbial penetration (EN ISO 22610 and EN ISO 22612) and*
- *Linting propensity (ISO 9073) to ensure that fibres are not shed beyond a set parameter to ensure that desired levels of quality standards are maintained during surgical procedures.*

The manufacturers of these products are required to provide full technical specifications, including materials used, methods of manufacture and performance, and to meet the tests required by European Norms, UK Government and the NHS. The documented purchasing specifications must also include any derogation protocols.

They are required to clearly specify laundry instructions, including wash and dry specifications as necessary to preserve the technical and functional safety of the products. Every product tapers off in its performance and it is important to know when to decommission a product on safety grounds. Therefore, the supplier is required to specify the intended maximum number of laundry cycles before removal from use. This information needs to be displayed on a label affixed to the product or provided to the owner of the garment in an accessible format.

Outsourcing the care of PPE

When you consider all the information that the supplier is required to provide to the user, it is clear that the users need to follow the information and advice, and have the capability to apply them in practice. When nurses take their uniforms home for washing, the traceability is lost and the wash process is inconsistent with the instructions provided by the supplier. The same applies to PPE in any sector or workplace. A managed service, provided in-house or by and external laundry service, has systems in place to ensure that the care and maintenance products are aligned with how they were designed. This helps ensure that the wearers are protected and the textile products are used as they are intended.

The idea of employers encouraging their staff to maintain and care for their work-related technical textile products in their home washing machines is not only absurd, but also plagued with a multitude of risks. Although there are a large number of employers fully aware of these risks, we still see people working in healthcare, railways, manufacturing, retail, the auto industry and so on asked to wash these products at home.

An increasing number of operators in both industry and healthcare are outsourcing the care of their PPE to specialist commercial laundries. Throughout its working life, the garment's performance is monitored and controlled by the laundry under a contracted rental service agreement.

Bar-coding, QR coding and RFID (electronic tag) systems are commonplace for rental service control. They offer huge benefits in terms of monitoring the garment, ▸

since they enable the life, the number of laundering cycles, repair history, sizing and wearer comments to be logged throughout its life. A typical rental contract may also include non-destructive performance testing, which is undertaken at specified intervals. The contract will typically cover the regular re-treatment of the garment and any repairs that may be required, helping to ensure the maximum service life of the garment is achieved, with optimum sustainability.

Commercial laundries are much better equipped to filter and manage industrial effluents and dangerous pathogens. Their equipment, chemistry and filtering processes are designed to handle medical and industrial waste in a responsible way. Home settings are just adequate for textiles used in a domestic context. Home washing machines, drainage and waste management are not adequate to handle the industrial waste that exits from workwear and uniforms.

Encouraging good practice in the workplace

Properly looked after and well-maintained PPE can make a real difference in staff morale. Wearers will take both confidence and pride in the appearance of workwear that is correctly managed and in pristine, fit-for-purpose condition. In a food factory, restaurant, hospital, electronics and pharmaceutical environments, the wearing of properly maintained PPE is essential. In these sectors, most people manage their life-saving duties with care and humility. However, a casual approach to handling PPE is prevalent and should not be tolerated. This is partly to do with not understanding the importance of handling infectious textile products. Even in critical areas such as healthcare you may see an operating room consultant wandering down the hospital corridor in their scrubs, or a hospital nurse or carer wearing their uniform on the bus. In fact, TSA has worked with De Montfort University's (DMU) Infectious Disease Research Group, researching the practice of NHS nurses laundering uniforms at home. The findings suggest that this practice is hazardous, proving that some domestic machines are simply not up to the task of decontaminating clothes.*

The Covid pandemic saw practices being implemented and a new culture was developed that focused on safety and protection in just about every area where PPE is used. Sadly this has proved to be temporary and, in many sectors, the old casual ways have returned as the norm. Training, especially with new staff, is essential to maintain the right approach to PPE. Staff changes and absenteeism can result in the wrong garment being used, which in turn can result in injury, discomfort or misuse and the loss of product control.

The virtuous circle

However tough the environment PPE workwear is employed in, end-of-life circularity can be achieved in many cases by recycling the fibres in a controlled manner, rather than simply destroying the garment. This can result in reconstituted fabrics, providing a more sustainable solution.

However, no matter how 'smart' or technical the fibres, fabrics and garments may be, the bottom line is that PPE needs to be not only specified correctly but also maintained correctly. If not, the results could be fatal.

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** 'Variable decontamination efficacy of domestic washing machines: potential risks for home laundering of healthcare uniforms' was carried out by DMU's Infectious Disease Research Group, with funding from the TSA. It was presented at the Infection Prevention Society (IPS) Conference in October 2022.* ■

Author

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As well as being Director of Programmes and Projects at the TSA, Shyju Skariah facilitates the PPE workwear working group, one of the Association's 'active knowledge networks' attended by the leading operators in industry. As well as overseeing TSA's programmes and portfolios, Shyju facilitates the development of British and International standards for the textile services industry. The TSA knowledge networks are the leading best practice sharing platform in the textiles service industry and cover a variety of areas, ranging from technical standards, health and safety, sustainability, industry training and apprenticeship to research and development.

The TSA is the trade association for the UK's textile care services industry. The TSA represents commercial laundry and textile rental businesses. Membership ranges from family-run operations through to large, multi-national companies. Visit www.tsa-uk.org for more information.