

# **FIRE**

**PPE  
Focus**

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## **Inspectorate results under scrutiny**

Following the Inspectorate's first tranche of reports, *FIRE* examines the implications for the Fire and Rescue Service

## **Government response to Hackitt**

The fire sector welcomes the government's agreement with the Hackitt Review's recommendations

## **Bristol Uniforms puts PPE to the test**

Pavilion Publishing and Media Ltd

**Ivan Rich, Technical Manager at Bristol Uniforms, reports on the various testing phases associated with good quality PPE**

# PPE put to the test

**F**irefighter PPE is subject to rigorous testing at every stage of its development to ensure it offers good protection and meets the relevant international standards. With the advance of technology, these tests are becoming ever more sophisticated, assisting with the development of new fabric combinations and designs, and offering vital reassurance to fire and rescue services that they are purchasing PPE that meets requirements.

## Fabrics and Fibres

Even before firefighter garments are designed, the fibres and fabrics that will be used to create them are subject to a host of assessments undertaken by fibre and fabric manufacturers, providing evidence of their particular strengths and qualities, and demonstrating their adherence to relevant standards, such as the European CEN standard for firefighting PPE, EN469.

Fibre manufacturers PBI Performance Products and Dupont, for example, test their specialist fibres for resistance to flame and heat, and the decomposition temperature at which the fibres start to degrade.

Specialist fabric manufacturers, such as Hainsworth and W.L. Gore & Associates, will then select fibres with specific qualities to create fabrics suitable for particular applications, and undertake further tests to demonstrate their characteristics and strengths. W.L. Gore & Associates creates protective moisture barriers which are tested for breathability and thermal stability when exposed

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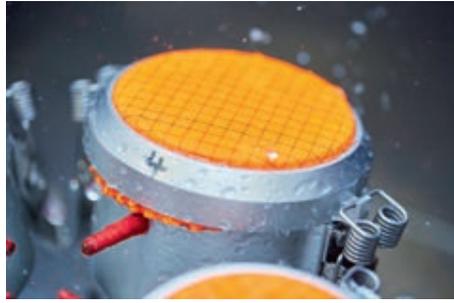


BTTG RALPH manikin test

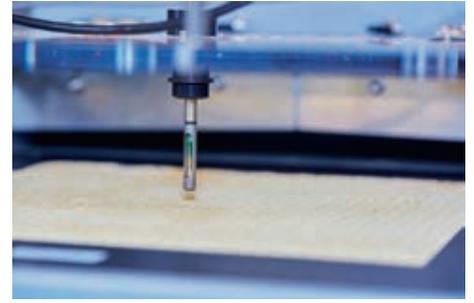




BTGG heat radiation test



BTGG Wira shower test



BTGG water vapour resistance test

to extreme heat, as well as resistance to blood, sweat, common chemicals and water. Hainsworth also puts its fabrics through robust assessments and has its own UKAS accredited laboratory offering a range of standard tests for evaluating specific textile properties.

### Fabric Combinations

When designing a new firefighter garment, PPE manufacturers select samples from fabric suppliers and then carry out further testing and research into how the materials behave in combination. High quality firefighter PPE is usually made up of layers of different fabrics with unique properties. The outer layers protect against heat and flame and will neither melt nor ignite. The inner moisture barriers are micro-porous, preventing water ingress while allowing perspiration and heat to escape. Finally, another soft layer of material is often used inside the garment against the skin to ensure it is comfortable to wear.

At Bristol we use an independent UK testing centre, BTGG, to undertake a series of assessments on both composite and single layers for every new product, to ensure the final material chosen offers the desired levels of protection and comfort, and meets the requirements of international standards.

BTGG offers a wide range of robust laboratory tests against European (CEN) and International (ISO) standards,

investigating flame spread, heat resistance, tensile tear and seam strength, surface wetting, penetration by liquid chemicals, water penetration, dimensional change after washing, water vapour resistance, thermal resistance, abrasion resistance, and cut, tear and puncture resistance.

Before the majority of these tests, BTGG will wash and dry the materials five times in accordance with the manufacturer's instructions. This is to check that the protective qualities of the fabric remain intact and are not diminished after cleaning.

At this stage, in addition to the principal fabric combination, all other possible components of the PPE are tested, including studs, webbings, graphics, badges and reflective tape. All are tested to see how they react to intense heat and flame, and how this might affect the performance of the PPE ensemble.

### Prototypes

Once a new product design is created by designers in our Product Innovation Development department, and the new fabrics have been tested, full prototypes of the new garment are developed for further assessment.

These prototypes are sent back to BTGG for further testing on ergonomic performance and compatibility. For these tests, a wearer puts on the garment and undertakes a number of specific physical activities, before providing feedback on comfort, fit and ease of movement. Measurements are also taken before and after each activity to ensure compatibility with other elements of the uniform and its accessories such as helmets, hoods, gloves and boots. For example, overlaps are measured to ensure that there are no gaps leaving areas of the body vulnerable to harm.

### Manikin Flame Engulfment Tests

Although not mandatory, additional manikin tests to check how garments perform under flash fire conditions, are also available. In these tests, a manikin with specially fitted heat sensors is engulfed in flames while wearing the new designs. These tests are sometimes specified by the customer as part of a tender process to directly compare the performance of different models



BTGG tear strength test

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from different manufacturers. At Bristol, we often use manikin tests during new product development to help identify areas of the body where improvements in protection are required.

There are around 17 test centres in the world certified to undertake manikin tests for firefighter PPE, which work to the international standard, ISO 13506: 2017. This standard is currently under review to try and minimise possible variables between test centres.

BTMG has undertaken manikin tests for 30 years, first with the male shaped model RALPH (Research Aim Longer Protection Against Heat), who was updated in 2006 and joined by female-shaped model SOPHIE (System Objective Protection against Heat In an Emergency). Both comply with ISO:13506 and test clothing under full flame envelopment conditions.

RALPH and SOPHIE have over 120 sensors distributed over the head, torso, legs, arms and hands which monitor the temperature on the surface of the manikin during a test. The flame engulfment apparatus consists of 12 burners with the manikin at the centre. For each test, a burn injury prediction is produced, indicating levels of pain, first, second and third-degree burns.

Although this test is optional, it can give a useful guide to the performance of an ensemble, particularly when all tests are carried out at the same test centre under the same conditions. Manikin testing was specified for the recent UK Collaborative PPE Framework tender process, with ensembles tested at the beginning of the process when initial designs were submitted, and then again at the end of the process once the final designs had been agreed.



#### User Trials

At Bristol, once a new product has been designed and fully tested in the laboratory, we like to undertake further testing in the form of user trials with selected customers. By asking firefighters to try the garments, we can gather valuable feedback on how it really feels to wear the kit on the job, and can make adjustments if required.

#### Particulate Protection

Over and above these established tests, in recent years, Bristol has been involved in the development of ground breaking new products which require additional testing procedures. Following indications from several international research studies that there is a possible link between carcinogens found in smoke particles and higher rates of cancer among firefighters, Bristol developed and launched the revolutionary Particulate Protection Hood. The hood features Nomex NanoFlex, which has been specifically developed to prevent contamination from potentially harmful particles, and offers protection for the most vulnerable areas of dermal exposure around the neck and face.

The Particulate Protection Hood underwent sophisticated testing in the USA to prove that it is 99.8 per cent efficient at filtering harmful smoke particles. It also passed standard tests for the new European standard for fire hoods, EN13911:2017.

In summary, the testing of firefighter PPE is becoming ever more rigorous and sophisticated as we take advantage of new technologies available to us and look to further improve firefighter protection. Testing can provide a valuable benchmark to ensure products available on the market meet a certain level of protection, and can help FRSS compare options for kit they are looking to purchase for their crew. Moreover, testing also plays an essential role in the development and fine-tuning of new products to help manufacturers innovate and adapt to new challenges.

