MSA The Safety Company

BRISTOL

Introduction - Technical

WHEN YOU GO IN, WE GO IN WITH YOU.

Bristol - a global force in firefighter protection

Relied upon by fire services in over 110 countries, Bristol is a global leader in the design, manufacture and supply of protective clothing for firefighters. We command a dominant share of our home UK market, whilst our products and support services are also delivered via a network of over 70 experienced distributors, to a number of major overseas markets.

Since the business began back in 1801, we have evolved from a manufacturer of gentlemen's clothing, to supplier of uniforms to public sector organisations in the 1930s, to developing the first fire protective clothing for firefighters at RAF airfields in the 1960s, to pioneering the original home office firefighter PPE specification in the 1970s. Today we continue to innovate as a leader on the international stage.

Our strong reputation for quality and service has been built on our many years of experience in the development of innovative protective clothing solutions. Our cutting-edge design, product development, wearer trials and integrated manufacture are all managed internally. In addition, in the UK we offer in-house managed services contracts for regular cleaning, inspection and repair, delivered through our Western Service Centre in Bristol and Eastern Service Centre in London.

All our products are made to conform to appropriate standards, principally for structural firefighting, including EN469 for Europe and NFPA1971 for North America. Our processes are controlled by a comprehensive quality management system, externally accessed and conforming to the requirements of ISO 9001.

1801 1910

Bristol is a member of the BTQ Group with affiliate companies in the USA including Topps Safety Apparel and Quaker Safety, both of which have leading positions in the North American flame resistant and protective clothing markets.

Through constant innovation and the support of our skilled and dedicated workforce, we are committed to continue leading the way in protecting firefighters across the globe.

1970 1980 2000 2015

Bristol - protecting the world's firefighters

With a network of 70 distributors supplying over 110 countries, Bristol's global presence in the firefighting personal protective equipment (PPE) market is unquestionable.

Each distributor is carefully chosen to ensure the finest technical standards, sound business principles and a commitment to the very best in customer service.

Knowledge built up over many years has given us a unique insight into the needs of firefighters around the world - and that process continues.

For the list of country distributors visit
www.bristoluniforms.com

World class standards

To ensure the best level of protection from firefighters' PPE, most countries demand conformity with national and international standards of performance. Since the early days of modern firefighting, Bristol has been actively involved in supporting the work of the organisations that set these standards, contributing our technical expertise, built up over 50 years of developing, designing and manufacturing firefighting PPE.

With a global presence in the supply of firefighter clothing, Bristol meets all internationally recognized standards, as well as other national standards, including German HuPF and Australian Standard AS/NZ 4697: 2009, Austrian Standard AS-04, and Russian Standard.

The principal standard setting bodies cover Europe (EN standard), the USA (NFPA standards) and a worldwide international group which sets ISO standards. In Europe, the current standard for Structural Firefighting is EN469:2005, drafted by European committee CEN/TC162.

In complete form, EN469 tests for compliance with:

- Heat transfer of flame and radiation
- Resistance to liquid chemicals
- Water vapour resistance

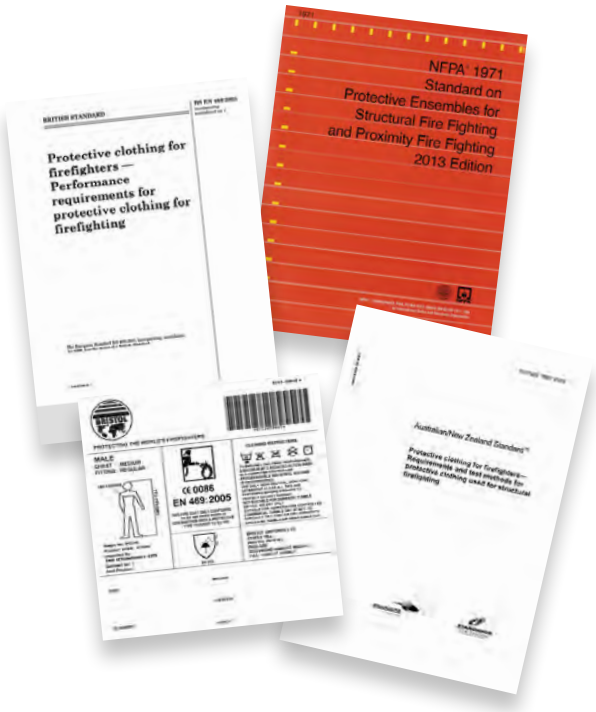
In the USA, the current standard NFPA1971: 2013 in complete form, calls for compliance with:

- Thermal Protective Performance (TPP)
- Conductive and Compressive Heat Resistance (CCHR)
- Total Heat Loss (THL)
- Transmitted and Stored Thermal Energy Test

The international standard ISO11613-1999 has two measurement methods: approach A, which is similar to EN469, and approach B, which has similar performance to NFPA1971. The chart opposite summarises the performance properties between test methods used for the various standards.

In developing new products, manufacturers need to know how their products will perform in flash fire conditions. It is here that life–sized test mannequins, designed especially to measure the performance of protective garments under these conditions, are used. Bristol uses two such test models: DuPont's Thermoman, based in Geneva, and British Textile Technology Group's (BTTG) male and female mannequins, named Ralph II and Sophie. By using this simulating test during new product development, we collect detailed data from which we can identify areas of the body where an improved level of protection is required.

Whilst mannequin testing is included in EN469: 2005, **it is not mandatory and there are no dedicated test criteria.**



Glossary of Terms

TPP = Thermal Protective Performance

This sophisticated test method replaced the requirement for a minimum composite thickness. Its purpose is to measure the time elapsed for convective and radiant heat to penetrate through the composite system – outer shell, thermal liner and moisture barrier – to damage the human skin.

THL = Total Heat Loss

This test specifically measures the ability of the garment to let heat pass away from the body through the 3 composite layers that make up the jacket and pants – in short, breathability.

CCHR = Conductive and Compressive Heat Resistance

This test is intended to ensure that the shoulder and knee will provide the same level of protection as the rest of the garment when compressed. The test is run in both wet and dry conditions.

Heat Transfer (Radiation)

This test measures the time it takes for a given amount of radiant heat applied to the outer surface of the material or material assembly being tested to raise the temperature by a specific number of degrees on the inside surface.

Heat Transfer (Convective)

This test identifies the shielding factor that the material or material assembly of the garment will have against the transfer of heat generated by a flame. It measures the time taken for this heat to pass from the outer surface of the material or material assembly and raise the temperature by a specific number of degrees on the inside surface.

Water Vapour Resistance

This test is to ensure that, if a moisture barrier is included in the garment, it will not only provide the required level of protection against the transfer of water droplets but will also allow a certain amount of breathability. The measurements used to establish this are thermal resistance (Rct) and water vapour resistance (Ret).

Resistance to Liquid Chemicals

This test is to ensure that the material or material assembly of the garment gives a required level of repellency to liquid chemicals and prevents penetration to the innermost surface of the material or material assembly of the garment.

Transmitted and Stored Thermal Energy Test

This test method provides procedures for measuring the combination of transmitted and stored energy that occurs in firefighter protectve clothing material systems as the result of exposure to prolonged, relatively low levels of radiant heat. Tests are carried out only on sleeve composites containing enhancements, e.g. reflective trim and reinforcement panels.

Fabric Layer	Property	Europe EN469:2005	USA NFPA 1971:2013	International	
				ISO 11613:1999 Approach A	ISO 11613:1999 Approach B
Composite or Component Assembly	Heat Transfer (Flame)	■	–	■	–
	Heat Transfer (Radiation)	■	–	■	–
	Resistance to Liquid Chemicals	■	–	■	–
	Water Vapour Resistance	■	–	■	–
	Thermal Protective Performance (TPP)	–	■	–	■
	Conductive and Compressive Heat Resistance (CCHR)	–	■	–	–
	Total Heat Loss (THL)	–	■	–	–
	Stored Thermal Energy Test	–	■	–	–
	Conductive and Compressive Heat Resistance (CCHR)	–	■	–	–
	Conductive and Compressive Heat Resistance (CCHR)	–	■	–	–
All layers (tested separately)	Heat Resistance	■ (5%)	■ (10%)	■ (5%)	■ (10%)
	Dimensional Change	■ (3%)	■ (5%)	■ (3%)	■ (5%)
Outer Material	Flame Resistance	■	■	■	■
	Residual Tensile Strength	■	–	■	–
	Tensile Strength / Breaking Strength	■	■	■	■
	Tear Strength	■	■	■	■
	Surface Wetting / Water Absorbtion	■	■	■	■
Moisture Barrier	Water Penetration Resistance	■	■	■	■
	Resistance to Liquid Chemicals	–	■	–	–
	Viral Penetration Resistance	–	■	–	–
	Tear Resistance	–	■	–	■
	Flame Resistance	–	■	–	–
	Light Degradation Resistance	–	■	–	–
Thermal Barrier	Flame Resistance	■	■	■	■
	Tear Resistance	–	■	–	■

Using the best fabrics to achieve outstanding performance

Fabric choice

Protective clothing for firefighters is manufactured from three layers: outer layer, moisture barrier and thermal barrier.

The choice of fabrics available for each of these layers is described below.

Outer

The following fabrics are supplied and recommended by Bristol because their properties and construction are such that they will neither melt nor ignite.

NOMEX® TOUGH - Widely used over many years by fire brigades throughout the UK and Europe, Nomex® Tough has proved its durability for the rigours of firefighting. It comprises 75% Nomex®, 23% Kevlar® for strength and 2% P140 carbon fibre (which gives the fabric its anti-static properties). It is available in 195 g/m2 twill weave in a variety of colours. This fabric gives excellent tensile and abrasion resistance.

TITAN This is a patented TI-technologyTM fabric design manufactured using a Nomex®/Kevlar® fibre combination. Because the system uses the 'ACTIVE AIR ENTRAPMENT' system, coupled with the added strength, it offers the highest levels of thermal protection and garment integrity.

TITAN1220 A 220gsm outer shell fabric featuring DuPont™ Nomex® and DuPont™ Kevlar®. TITAN1220 is a highly breathable fabric designed primarily as an outer shell for structural fire fighter garments, reducing the risk of heat stress by keeping you cool and comfortable, whatever the situation. Tried, tested, and requested by fire fighters worldwide, TITAN1220 combines the flame resistant properties of Nomex® and Kevlar® to provide dynamic thermal protection and outstanding durability even in the most demanding situations.

The fabric composition is 89% Nomex®, 9% Kevlar®, 2% Antistatic.

TITAN1250 A 270gsm outer shell or single layer fabric featuring Nomex® and Kevlar®. TITAN1250 is a highly breathable fabric, used both as an outer shell fabric for structural fire fighter garments, and as a single layer fabric in riot police coveralls. The inclusion of a higher percentage of Kevlar® in the composition ensures the fabric has outstanding tensile and tear strength for the most demanding situations.

The fabric composition is 59% Nomex®, 40% Kevlar®, 1% Antistatic.

TITAN1260 A 220gsm outer shell or single layer fabric featuring Nomex®, Kevlar® and Pbi®. TITAN1260 is a highly breathable fabric used as an outer shell fabric for structural fire fighter garments. Like its stable mates TITAN1220 and TITAN1250 this fabric features the unique and innovative 'Active Air Entrapment', provided by the double cloth construction. The inclusion of Pbi® fibre increases thermal integrity, ensuring that, after cooling, the fabric remains flexible and intact, and does not break open after flashover. The fabric uses a specially developed proprietary yarn with smoother surface to maximise breathability by reducing fibrillation. The Nomex® yarn is slightly raised to protect the Pbi® yarn and thus improve abrasion resistance.

The fabric composition is 74% Pbi® (proprietary blend), 23% Nomex®, 3% Kevlar®.

PBI Gold is an exclusive blend of fibres that provides protection and comfort. This fabric does not shrink or become brittle after exposure to heat or flame. PBI Gold gives you extra time and mobility to be effective and to get out quickly from the heat and flame, when every second counts.

The fabric composition is 40% PBI and 60% Para-Aramid and is available in a ripstop plain weave, 205 g/m2. The natural colour is gold but other colours are available.

PBI Matrix® is a durable matrix of high-strength Aramid filaments which have been woven into the PBI Gold fabric to enhance and reinforce its resistance to wear and tear whilst retaining its heat and flame protection. This fabric does not shrink or become brittle after exposure to heat or flame.

The fabric composition is 40% PBI and 60% Para-Aramid and is available in a plain weave of 205 g/m2. The natural colour is gold but other colours are available.

Other PBI fabrics are also available, such as PBI MAX.

Other fabrics. Fibre producers and weavers are constantly introducing new developments, and Bristol can supply outershell fabrics in addition to those described above.

Moisture Barrier

Moisture barriers manufactured by Gore & Associates are the primary choice for firefighting clothing produced by Bristol. The micro-porous breathable fabric performs a dual role: stopping water passing through to the firefighter's personal clothing while allowing perspiration and heat to escape to the outside atmosphere. This reduces any heat stress the firefighter might suffer.

The moisture barriers are extremely durable, ensuring that the properties of the fabric last the lifetime of the garment.

Gore & Associates products available from Bristol are:

GORE Creative Technologies Worldwide

GORE-TEX® CROSSTECH® FIREBLOCKER moisture barrier is an ePTFE membrane laminated to a non-woven substrate.

GORE-TEX® CROSSTECH® AIRLOCK moisture barrier - A unique combination of thermal protection and moisture barrier which eliminates the need for extra-thick insulation. The innovative construction uses thermally stable and chemically resistant foam silicone spacers to create an Insulating air cushion, giving a very high level of thermal protection without a bulky and restrictive insulation layer.

GORE-TEX® CROSSTECH® FLAMELINER G moisture barrier is an ePTFE membrane laminated to a woven 50% Aramid/50% Viscose FR fabric.

GORE PARALLON

The GORE-TEX® CROSSTECH® PARALLON™ system has been developed to specifically combat the risks associated with moisture and heat stress by introducing a unique new solution that incorporates a highly breathable Gore thermal barrier combined with a GORE-TEX® or CROSSTECH® Moisture barrier.

This is a unique use of two membranes encapsulating a layer of thermal protection that maintains breathability while wicking moisture away from the skin and out through the suit, simultaneously preventing liquid penetration from the outside.

GORE® ParallonTM Moisture barrier laminate with quick redry moisture management properties.

GORE® ParallonTM Thermal barrier laminate with critical thermal protection coupled with membrane for additional moisture protection.

Thermal Barriers

Quilted Barriers

The lightweight thermal barrier used by Bristol is 100% Aramid non-woven felt and is quilted to either:

- Nomex Delta C
- Nomex Viscose
- FR cotton

ECO-DRYCOOL lining, which is lightweight incorporating wool/Lenzing FR to transport moisture vapour, in the form of sweat, through the liner. The hygroscopic nature of wool absorbs moisture and keeps you dry without feeling cold or wet. Weight 135 g/m2.

ECO-DRYACTIVE has a unique double cloth construction which has all the features of the above but with the double cloth construction which gives enhanced thermal protection. Weight 220 g/m2.

Weaves

Twill

Diagonal twill gives good tensile strength and abrasion resistance.

Plain weave

This usually consists of an equal number of warp (down) and weft (across) yarns, so that there is no diagonal weave effect.

Rip stop (twill or plain weave)

This produces a raised self colour check effect, retaining virtually all of the abrasion resistance of normal twill. A thicker gauge or superior strength thread used periodically in both warp and weft directions gives a subtle checked appearance, and prevents tears becoming larger.

Making clothing to order ensures best protection and comfort

Almost every fire brigade has its own special requirements when equipping operational teams: for instance, the type of radio used, where it is to be located with the associated mic loop and PPT fittings.

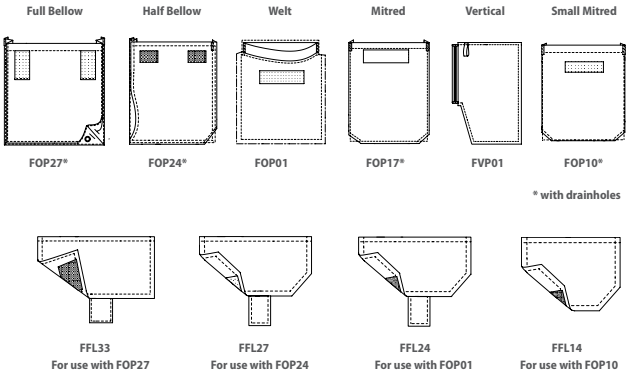
These needs are catered for by Bristol's bespoke approach to PPE specification, using our core designs (found in the Bristol structural firefighting catalogue). The addition of special features is tailored to each fire brigade's needs.

Bristol can provide technical support in preparing specifications and tender documents.

This bespoke approach meets the unique need of each firefighter, as each element of the garment is tailored to the individual's requirements. Bristol has over 400 product feature variations. Some are shown and full details are available from your Bristol distributor.

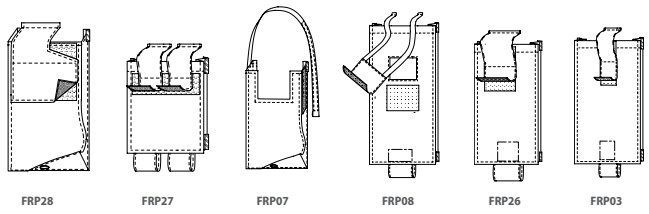
Pockets and flaps

A large number of pockets are available with flaps which can be external or internal. The sizes available vary, depending on the style of the garment and the function of the pocket. Bristol can offer, for example, patch pockets, welted pockets, bellow pockets or half-bellow pockets. Flaps can be hook and loop fastening, with square or mitred corners and with or without pull tabs.



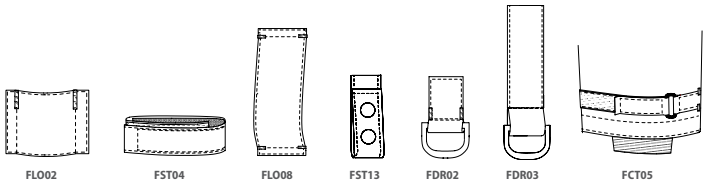
Radio pockets

There are a number of solutions available to accommodate the different sizes of radio used worldwide. The positioning on the garment can change to meet each customer's specific requirements.



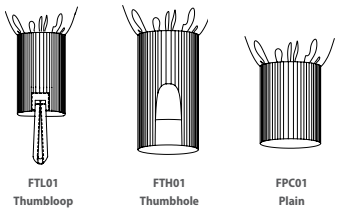
Loops, straps, D-rings and glove hooks

Loops can be fitted to the garments to accommodate a right angle torch, radio, microphone, and distress signal unit. In addition, a strap fastened by hook and loop is also used to attach some of these.



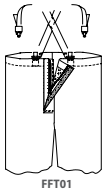
Cuffs

There are a number of solutions available for the knitted cuff, which can be supplied with a thumb loop, thumbhole or plain.

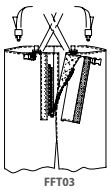


Trousers - Front

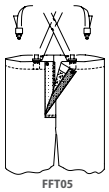
The alternative to a plain front trouser is to have a front opening which can be fastened by a zip, hook and loop or studs or a combination of all of these.



FFT01
Zip & Hook and loop



FFT03
Zip, Hook and loop & Buckle

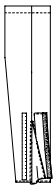


FFT05
Hook and loop

Trousers - Leg opening

A leg opening at the bottom of the trouser, for the ease of putting on footwear, is available if required. There are a number of solutions, which include fastening by zip and/or hook and loop.

FLE01
Zip & Hook and loop

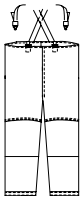


FLE02
Zip Gusset & Hook and loop

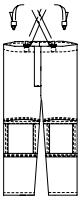
FLE03
Hook and loop

Knee Pads

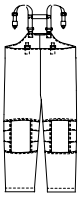
Bristol has a number of solutions available for knee pads, including various sizes of pad, outer fabrics and option with a shaped knee.



FKP10
Internal



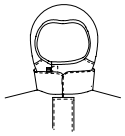
FKP11
Detachable



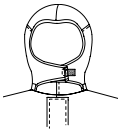
FKP18
Articulated Knee with Kevlar

Hoods

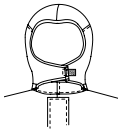
There are a number of solutions for a hood fitted to a fire coat. The hood can be fixed or detachable, fitted inside or outside the helmet, or can be stored away inside the collar.



FHD02
Detachable - Hook and loop



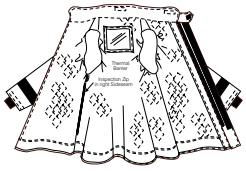
FHD03
Detachable Hood Zip



FHD04
Detachable - Zip foldaway into collar

Inspection zips

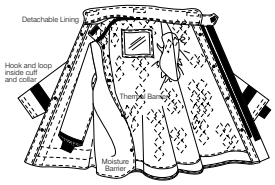
The Personal Protective Equipment Directive requires that clothing should be inspected during its operational life to ensure that it is fit for purpose. The inclusion of inspection zips helps the employer fulfill its obligations under the directive, and is available on coats and trousers.



FIZ01

Detachable Linings

Some brigades have a requirement for firefighting clothing with a detachable lining, which can be removed from the outer when required. The Bristol Uniforms solution is a lining which can be attached to the outer by a zip, hook and loop, press studs or a combination of these.



Patches and graphics

Graphic patches can be attached either directly onto the garment or to a patch of the outer material, and then fastened to the garment by hook and loop. The wording on the patch may be the name of a fire brigade, firefighter or simply “FIRE”, for example, in the language of the firefighter’s country. The size can be adjusted, depending on the style of the garment, and can be placed on the front or back, providing that it does not interfere with other fittings, such as reflective tape. We can also add the Brigade or company logo to the garment using a heatsealed badge.

FGR09
Letters

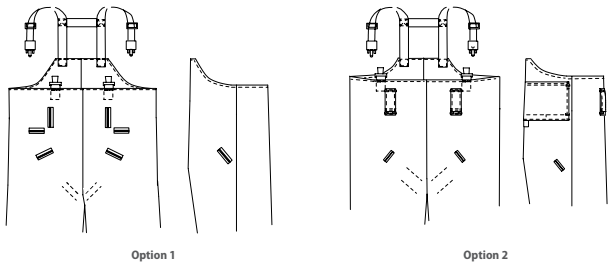
FGR10
Stencil Cut

FGR03
Small Detachable

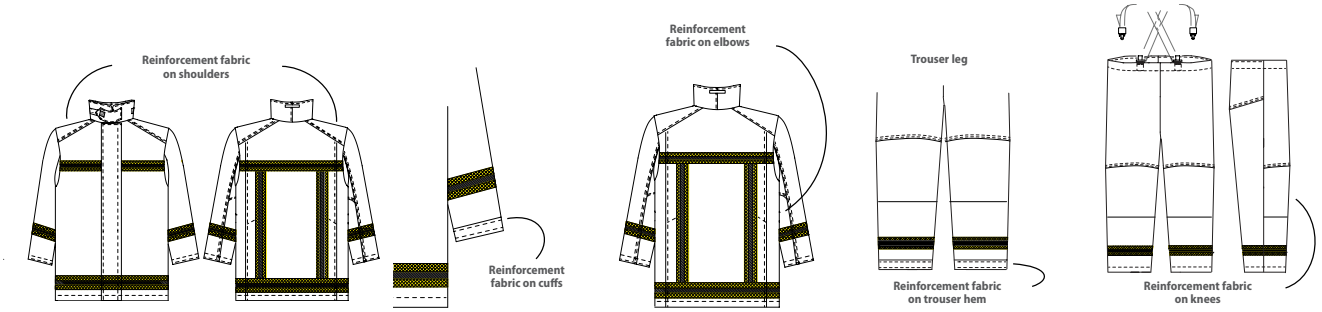
Introduction - Technical

Safety harnesses

Sometimes firefighters need to wear a safety harness at all times. As a solution to this requirement, Bristol has designed trousers with the facility for fitting a harness, and as an alternative, a fire coat with the facility for a harness to be worn underneath.

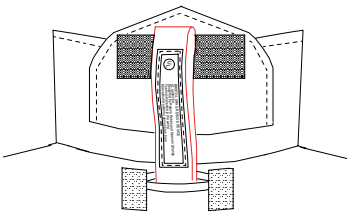


Arashield reinforcements



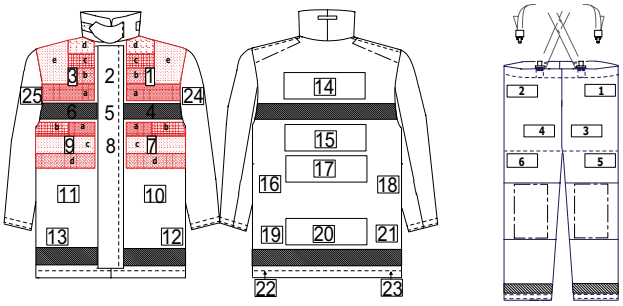
Drag rescue device

It is possible to provide a drag rescue device in some coats. This is a strong webbing device between the layers of the garment, accessible by means of a concealed loop beneath a flap at the back of the neck or by external straps across the shoulders. The purpose of the device is to help drag a prone firefighter to safety (and not for use as a lifting harness). Bristol's drag rescue device is tested to UL standards.



Feature Positions

This shows where it may be possible for a feature to be placed, subject to reflective trim and other pockets depending upon which garment you are using. Contact with Bristol or their nominated distributor can confirm exactly what is possible.

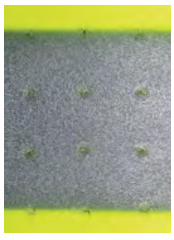


Trimsaver

This is a way to encapsulate the thread into a meta Aramid braid, thus protecting the thread from abrasion. In the long term, Bristol's Trimsaver offers considerable savings, reducing the likelihood of necessary repair of the thread by 87.5%.

Breathable Tape

Reflective tape, whether silver, yellow or triple trim, is added by a carefully controlled micro perforation process, to give a permeability of 160.4 g/m per 24 hours, compared to 10.6 g/m per 24 hour for non-breathable tape, and a Water Vapour Index (WVP) of 20.%, compared to 1.4% for standard tape. This therefore offers a reflective tape with the same conspicuity but with much greater breathability - and therefore comfort.



Every firefighter is unique

Wearer comfort and personal safety can be ensured only by correct sizing and good fit. To achieve this, Bristol has a comprehensive range of size fittings for both male and female firefighters. Careful design of all patterns ensures good garment fit, together with full compatibility with helmets, fire hoods, gloves and boots.

To accurately reflect and accommodate the different height and body shapes of fire-fighters around the world, Bristol has produced a range of 28 sizes and fittings for both male and female wearers.

If a wearer's size falls outside the standard size scale, our bespoke manufacturing capability allows for a special set of patterns to be made to meet those needs at an extra cost.

A guide to taking accurate measurements is shown in the pictogram. A Bristol distributor will be able to help with this exercise.

This is a general garment size indicator for male structural garments. A separate table applies for female, USAR, and marine. Further size information is available from Bristol and our nominated distributors. If a wearer falls outside these sizes, individual measurements will need to be provided. Your local distributor will be able to help.

Wearer's Height	Wearer's Chest	Wearer's Waist	Garment Size
164-171	92-99	82-89	SML SHORT
164-171	100-107	90-97	MED SHORT
164-171	108-115	98-105	LGE SHORT
164-171	116-123	106-113	XLG SHORT
164-171	124-131	114-121	2XL SHORT
164-171	132-139	122-129	3XL SHORT
164-171	140-148	130-137	4XL SHORT
172-179	92-99	82-89	SML REGULAR
172-179	100-107	90-97	MED REGULAR
172-179	108-115	98-105	LGE REGULAR
172-179	116-123	106-113	XLG REGULAR
172-179	124-131	114-121	2XL REGULAR
172-179	132-139	122-129	3XL REGULAR
172-179	140-148	130-137	4XL REGULAR
180-187	92-99	82-89	SML TALL
180-187	100-107	90-97	MED TALL
180-187	108-115	98-105	LGE TALL
180-187	116-123	106-113	XLG TALL
180-187	124-131	114-121	2XL TALL
180-187	132-139	122-129	3XL TALL
180-187	140-148	130-137	4XL TALL
188-196	92-99	82-89	SML X-TALL
188-196	100-107	90-97	MED X-TALL
188-196	108-115	98-105	LGE X-TALL
188-196	116-123	106-113	XLG X-TALL
188-196	124-131	114-121	2XL X-TALL
188-196	132-139	122-129	3XL X-TALL
188-196	140-148	130-137	4XL X-TALL

Safeguarding lifetime garment performance and integrity

European Union legislation requires employers to safeguard the health and safety of their employees at work. In the UK, this is enshrined in the Health and Safety at Work Regulations. In simple terms, a fire service has a responsibility not only to supply fire-fighters with PPE which meet all the necessary performance requirements, but also to have in place systems which ensure that the personal protection is regularly monitored, inspected and maintained, ensuring that it is fit for purpose throughout the equipment's life.

Managed service around the world

Although its origins are in the UK, the concept of managed service is becoming more widely recognised throughout European countries and further afield.

A number of alternative models are in operation, each designed to suit a country's particular needs. Audited Bristol systems are currently operating in France, The Netherlands, Slovenia, Finland, Spain, Australia and Japan.

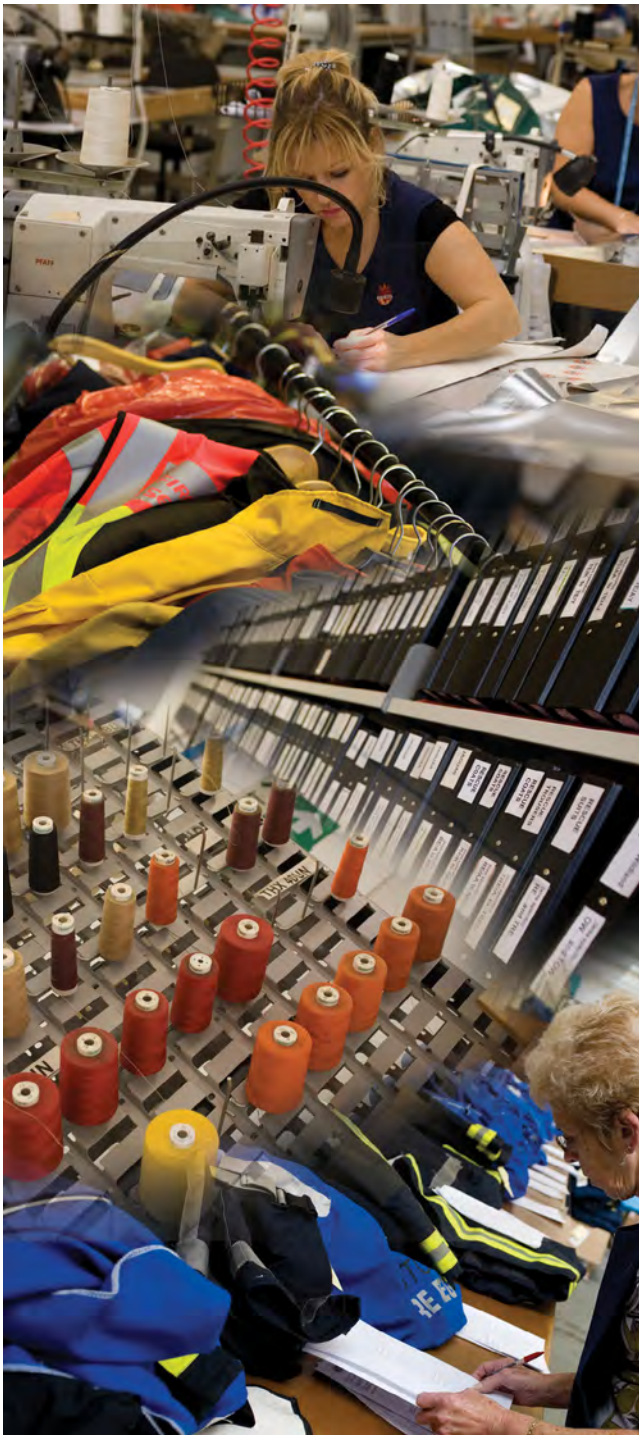
Managed service in the UK

Since the year 2000, Bristol, through our integrated managed service system, has provided cleaning/ decontamination, inspection, maintenance and garment tracking for most UK fire and rescue services and other organisations, such as airports and industrial locations.

Bristol's specially written software provides a database which records every single item of PPE through a unique identification barcode. This is then used to track the item throughout its working life and is linked directly to the wearer with information about their organisation, location and the issue of the kit involved. A user can see at a moment's notice every maintenance task, including inspection, washing, repairs, and decontamination and re-proofing, which builds into a detailed history of that item. It can be accessed by the wearer or the owner at any time and is a unique tool for the customer to plan and budget for eventual PPE replacement.

Bristol will collect and return the garments within 7 days and also carry out on-station repairs to items such as helmets.

The managed service in the UK is provided from two service centres, the Western Service Centre in Bristol, and the Eastern Service Centre in London.



The Managed Services' Cycle

Information available everywhere, any time

Bristol's extensive and comprehensive website is accessible in 5 languages: English, French, German, Spanish and Portuguese.

This includes a section for distributors, accessed by a discrete log-in, which gives further information to our partners around the world, so that help and information are available 24 hours a day, 365 days a year.

Please visit **www.bristoluniforms.com**, where you'll find this catalogue and much, much more.

MSA The Safety Company

BRISTOL

ABOUT
MSA – THE SAFETY COMPANY

Established in 1914, MSA Safety Incorporated is the global leader in the development, manufacture and supply of safety products that protect people and facility infrastructures. Many MSA products integrate a combination of electronics, mechanical systems and advanced materials to protect users against hazardous or life-threatening situations. The company's comprehensive product line is used by workers around the world in a broad range of markets, including the oil, gas and petrochemical industry, the fire service, the construction industry, mining and the military. MSA's core products include self-contained breathing apparatus, fixed gas and flame detection systems, portable gas detection instruments, industrial head protection products, fire and rescue helmets, and fall protection devices.

Accompanying you in firefighting, emergency response and search and rescue, our Bristol line is one of the world's leading emergency services protective clothing brands, with history dating back to 1801.

WHEN YOU GO IN, WE GO IN WITH YOU.

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