

# WHY DYNEEMA BALLISTIC MATERIAL?



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## WHY TO CHOOSE DYNEEMA MATERIAL FOR YOUR BALLISTIC PROTECTION?

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MINISTRY OF PUBLIC ORDER CERTIFIED  
ISO CERTIFIED  
ICoC SIGNATORY COMPANY

**Dyneema® is a highly advanced fiber based on an ultra-high molecular weight polyethylene (UHMWPE).**

It is incredibly strong - 15 times stronger than steel. Yet it's extremely lightweight—up to 40% lighter than materials like Kevlar or aramids.

A patented gel-spinning process gives Dyneema® unique, highly-directional attributes that allow for its unmatched strength-to-weight ratio.

This all makes Dyneema® an indispensable choice for designing and manufacturing Soft and Hard Ballistic Armor in Helmets, Vest, Ballistic Inserts, and Vehicle Armor for land, air, and sea.

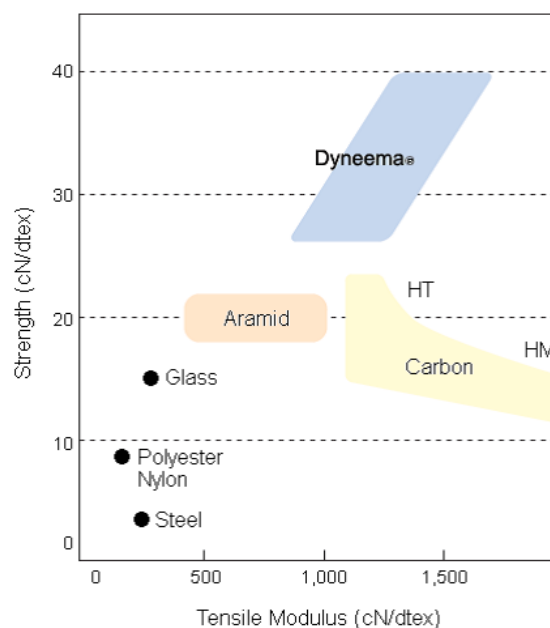
### Dyneema® vs Kevlar

A Comparison of Ultra High Molecular Weight Polyethylene (UHMWPE-Dyneema®) to Aramid Fiber (Kevlar) Performance

#### UV Light Stability & Strength

UHMWPE when exposed to UV light only losses about 5% of it strength over about a 2 day period. Glove cut resistance changes little due to exposure to sunshine.

Under the same conditions Aramid fiber losses about 25% of it strength over about 2 days. Performance deteriorates rapidly.



### **Heat Conductance & Comfort**

UHMWPE yarn provides maximum comfort because it can disperse (body) heat quickly. It conducts heat like steel. Its heat conductance is 40 W/mk

Aramid fiber is insulative with a heat conductance of only 0.04 W/mK. Body heat cannot easily move off the skin and the gloves build up heat and become sweaty.

### **Water Exposure**

UHMWPE fiber is water resistant. It does not swell or breakdown in water and it maintains performance in wet or humid conditions. It absorbs no water.

Aramid fiber absorbs about 3.5% of its own weight in water. The gloves become damp and sweaty and Performance deteriorates.

### **Strength**

The world's strongest fiber: 15 times stronger than steel; 40% stronger than Aramid fiber. Aramid fibers are the second strongest: 7 times stronger than steel.  
40% Less than Dyneema®

### **Feel & Weight**

UHMWPE is light weight: actual density is only 970 kg/m<sup>3</sup>. It floats in water and feels light and comfortable. Aramid fiber density is 1440 kg/m<sup>3</sup> and it is heavier, more uncomfortable and bulkier in both garments and gloves.

### **Flexibility Comfort Durability**

It is the only "superfiber" that does not break if bent or folded.

The relative flex life of UHMWPE is 100 versus only 8 for Aramid fibers. This means performance remains the same no matter how many time the hand is flexed or fingers bend.  
All day performance.

Aramid fiber is more brittle than UHMWPE. Its flex life performance is 12 times worse than UHMWPE. As the hand is flexed and fingers bent the fiber cracks and breaks. Over time with each bending motion it loses its strength. Kevlar factories are covered in a "gold" dust because of this.

### **Abrasion Resistance**

UHMWPE has the best abrasion resistance of all fibers. It abrasion performance is between 2.5 and 8 times better than other fibers. When conditions are wet it boasts even better performance up to 40 times better.

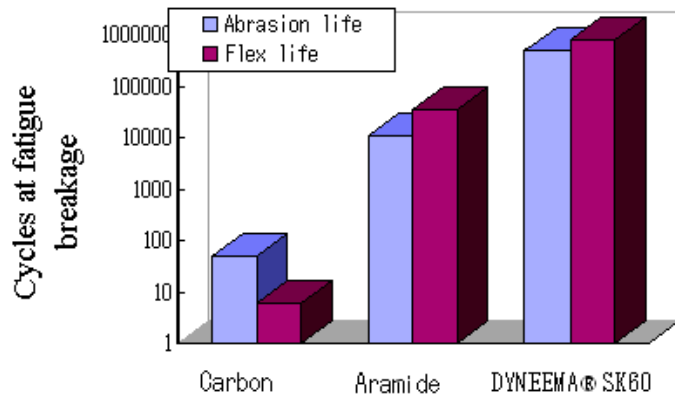
The glove's cut resistance performance remains predictably and consistently good.

Aramid fiber abrasion resistance is poor because of its poor flexlife. Tests have demonstrated that gloves made with Dyneema® have up to 20 times more abrasion resistance than gloves made with Aramid-based (spun) yarns. In a case study at Choice Fabricators Kevlar gloves wore out 4 times faster than Dyneema® gloves when used in the same operation.

### **Washable & Skin Friendly**

Ballistic vests, gloves etc made with UHMWPE can be washed dozens of times with no loss in performance.

They also meet the humano-ecological requirements for direct skin contact - Oeko-Tex std 100. Aramid gloves can suffer up to a 16% strength loss after just two washes. So cut resistance is significantly affected. According to Du Pont's Kevlar® MSDS CKSQM, acute exposure to its fibrous dust can cause irritation to the mucous membranes of the nose and throat.



### **DYNEEMA IS MOSTLY PREFERRED IN INDUSTRY AND APPLICATIONS**

- Commercial fishing**
- Industrial**
- Maritime**
- Offshore**
- Sailing**
- Personal Armor**
- Vehicle Armor**
- Aviation**

### **DYNEEMA HELMETS**

Helmets made with Dyneema® offer high levels of ballistic protection against threats including fast-moving fragments, FSPs, RCCs and many handgun projectiles, including various bullets.

Helmets made with Dyneema® offer a reduction in weight, increasing comfort and agility for those in the field. Helmets made with Dyneema® are typically up to 25% lighter than next-nearest competitive materials. Decreased weight also gives manufacturers and end users added flexibility. For example, users can choose to carry more life-saving equipment such as night sights or visors.

### **DYNEEMA VESTS**

Whether for military, law enforcement or civilian use, protective vests are essential for the personal protection of all those who put their lives on the line. Vests made with Dyneema® are easier to wear and easier to manufacture

Vests made with Dyneema® offer wearer protection against a range of threats - including handgun ammunition, fast-moving fragments, and knives - while providing the lightest weight options with maximum flexibility and comfort.

Vests with Dyneema® can be made up to 40% lighter, without a drop in ballistic performance. This reduced weight gives the user increased speed and flexibility, which significantly improves their ease of mobility. Alternately, this weight saving can be used to accommodate additional, potentially life-saving, equipment like surveillance devices.

Additionally, Dyneema® Soft Ballistic (SB) armor solutions can be upgraded with Hard Ballistic (HB) inserts, to address higher threats, such as rifle fire.

**DYNEEMA SB21 MATERIAL:** SB21 from DSM Dyneema is especially designed to support lightweight tactical vests. Vests made with SB21 are easier to wear, at a fraction of the weight, with far greater flexibility and comfort (they have no seams, which equates to less friction on the skin).

**Easy to wear/conceal** - Thinner and lighter compared to other materials like aramids. Good protection with ultimate flexibility and mobility.

**Low-back face deformation** - <35mm with .44 Magnum. Minimizes trauma to the body

**Cool and comfortable** - Best-in-class moisture and water resistance.

**Stands up to harsh use** - Excellent durability. Withstands extreme climates.

### **DYNEEMA INSERTS**

Dyneema® offers flexibility in choice and action, by reducing the weight of individual inserts, at the same protection level. Dyneema® also provides additional life protection options, when increasing the body surface coverage, without restricting movement or flexibility. For example, side panels can be added while maintaining the same weight.

Inserts made with patented Dyneema® Unidirectional (UD) material are regarded as best-in-class and are proven in combat situations to help guard against heavy-duty, multiple-hit threats including AK47 MSC (7.62 x 39 mm) and NATO Ball (7.62 x 51 mm).

With Dyneema®, the weight of individual inserts can be reduced by up to 25% compared to traditional materials like steel, while still offering the same protection level. This gives manufacturers and end users genuine choice and flexibility in how they design and deploy armor solutions.

### **DYNEEMA BALLISTIC SHIELDS**

With its unmatched strength-to-weight ratio, Dyneema® is the ideal material to incorporate into ballistic shields, such as those carried by SWAT teams and riot officers. Effective against a variety of projectiles, providing excellent mobility for materials used in frontline tools.

By reducing the weight of individual inserts at the same protection level, the option arises of increasing the body surface area covered, without restricting movement or flexibility. For example, side-panels can be added while maintaining the same weight.

### **DYNEEMA CIVILIAN APPLICATIONS**

Civilian applications, whether protecting VIPs or armoring non-military vehicles, often benefit from the low-profile strength that Dyneema® is famous for.

These days, the need for personal protection and greater security can extend beyond the worlds of national defense and police work. Dyneema® is here to help with a range of material grades well-suited for civilian markets. Our material is currently incorporated into a variety of applications where highest strength needs to be present in a discreet, practical fashion.

Whether you are a civilian, soldier, or a police officer, you can be assured that personal protection made with Dyneema® has what it takes to be with you when it matters.

Dyneema® offers life saving solutions for civilian applications, such as:

- Low-profile protective vests for public figures, VIPs, and their security staff.
- Reinforced bags, briefcases, and clipboards
- Protecting valuable and sensitive information or serving as improvised shielding.
- Secure cockpit doors, and protecting pilots and crew from emerging threats of all types.
- Armored vehicles where protection can't be compromised, but needs to be discreet and lightweight / low profile as well.

## **CONCLUSION**

### **ARAMID AND UHMWPE**

Body armor manufacturers take two totally different approaches - use two totally different materials - in their ballistic panels. One material is an aramid fiber. The other material is UHMWPE. Many body armor makers use both materials, one for one application and the other for another. A few body armor makers offer different lines of ballistic vests with aramid fiber used in one product line and UHMWPE in another.

Aramid fibers are a class of strong and heat-resistant synthetic fibers used in ballistic-rated body armor fabric. These "aromatic polyamide" fibers have highly oriented long-chain molecules along the fiber axis for the strongest chemical bonds.

In 1973, DuPont introduced the aramid fiber, Kevlar. It is this long chemical chain of very axis-oriented molecules that gives aramid fibers their ballistic properties. This strength is something that aramids share with another synthetic fiber, UHMWPE.

Ultra High Molecular Weight Polyethylene (UHMWPE), also known as high-modulus polyethylene or high-performance polyethylene has extremely long molecular chains. Longer chemical chains, those with bonds oriented along the axis of the fiber, spread out the load, force or stress. As a result, UHMWPE is a very tough material, with a very high-impact strength. It is widely used in ballistic protection and has a better UV resistance to breakdown than aramids. UHMWPE fibers were introduced in the late-1970s by the Dutch chemical company DSM under the trade name, Dyneema.

**DYNEEMA** is one of the armor industry's lightest weight options. It allows armor designers to cut weight and bulk without sacrificing ballistic protection. This allows modern armor designers and manufacturers to make life protection gear that is lighter and more comfortable.

Law enforcement officers are asked to carry more technology in the field. The extra weight adds up quickly. Dyneema® helps reduce the load, while still providing rated levels of protection in ballistic helmets, vests and inserts. In soft body armor, Dyneema Unidirectional has excellent multi-hit performance, angle shot performance, edge shot performance, structural performance, and lower backface deformation.

## PERSONAL ARMOR

Dyneema Soft Ballistic (SB) armor solutions are used in vests and clothing to provide protection against handgun ammunition. Dyneema Hard Ballistic (HB) armor solutions are incorporated into ballistic inserts and helmets to protect against heavier and more penetrating threats such as rifles and high-speed fragments, such as those from IEDs.

Soft body armor made with Dyneema gives the officer protection against a range of threats—including handgun ammunition—while providing the lightest weight options with maximum flexibility and comfort. Vests made with Dyneema are both easier to wear and easier to manufacture.

Ballistic vests with Dyneema can be made up to 40 percent lighter, without a drop in ballistic performance. This reduced weight gives the user increased speed and flexibility, which significantly improves their ease of mobility. Additionally, Dyneema Soft Ballistic (SB) armor solutions can be upgraded with Hard Ballistic (HB) inserts, to address higher threats, such as rifle fire.

Vest inserts made with Dyneema offer ultimate stopping power at lighter weight. By reducing the weight of individual inserts, at the same protection level, Dyneema also provides additional life protection options, when increasing the body surface coverage, without restricting movement or flexibility.

Inserts made with patented Dyneema® Unidirectional (UD) material are regarded as best-in-class and are proven in combat situations to help guard against heavy-duty, multiple-hit threats including AK47 (7.62 x 39 mm) and NATO Ball (7.62 x 51 mm). With Dyneema®, the weight of individual inserts can be reduced by up to 25 percent compared to traditional materials like steel, while still offering the same protection level. This gives manufacturers and end users genuine choice and flexibility in how they design and deploy armor solutions.

Helmets made with Dyneema offer high levels of ballistic protection against threats including most handgun bullets and fast-moving fragments. The use of Dyneema allows a reduction in weight, typically up to 25 percent lighter than next-nearest competitive materials. That means both increased comfort and agility in the field. Decreased weight also gives tactical officers added flexibility, i.e., they can choose to carry more life-saving equipment such as night sights or ballistic visors.

Ballistic shields made with Dyneema® are lighter to carry, improving mobility in the field. With its unmatched strength-to-weight ratio, Dyneema® is the ideal material to incorporate into ballistic shields, such as those carried by SWAT teams and riot officers. Effective against a variety of projectiles, it provides excellent mobility for materials used in frontline tools.

By reducing the weight of individual shield inserts at the same protection level, the option arises of increasing the body surface area covered, without restricting movement or flexibility.

DSM has published several studies into the ballistic resistance of artificially aged Dyneema fiber and Dyneema UD grades.

These studies found that - extrapolated to real-world conditions - both UHMWPE fiber and UHMWPE unidirectional composites from DSM Dyneema will retain their tensile properties and ballistic performance for five years. This is the typical baseline requirement for ballistic-resistant vests.

Even tougher tests have found no significant drop in the ballistic performance of the artificially aged samples. These are impressive results, but they are also theoretical results.



A real-world study explored the retention of ballistic performance of used and real-time aged vests, inserts and helmets made from Dyneema UD unidirectional composite.

The items, which ranged in age from five to 12 years old, had either been used by law enforcement officers or military officers in theater or stored.

The study found that these used and aged articles continued to perform in line with the specifications that applied when the articles were made and certified. The results are in line with the predictions of DSM's aging models.

***“From the results, DSM concludes that no significant changes in ballistic performances are observed for the aged articles, despite the fact that some are more than a decade old and show significant signs of wear and exposure to moisture.”***

# SB21

## Product Specification Sheet

SB21 is an Ultra-High Molecular Weight Polyethylene fiber based composite laminate for low weight soft armor applications. A roll of product consists of four single layers of unidirectional sheet cross plied at 90 degrees to each other, consolidated with a rubber based matrix and covered with a protective film.

Property	Test Method	Unit (Metric) <sup>1</sup>	Unit (Imperial)
Roll length <sup>2,3</sup>	DTM LPO60	≥ 200 m	≥ 219 yards
Roll width <sup>3</sup>	DTM LP199	≥ 1,60 m	≥ 63 inch
Areal density	DTM LP152	140 - 150 g/m <sup>2</sup>	4,13 - 4,42 oz/yd <sup>2</sup>
Spot defects <sup>4</sup>	DTM LP156	≤ 15 per roll	≤ 15 per roll

<sup>1</sup> Metric units are leading throughout this document

<sup>2</sup> Net length is excluding spot defect compensation

<sup>3</sup> In case of a non-full roll length or width, the dimensions are specified in the box information sheet, supplied with every box

<sup>4</sup> Spot defect definitions are given in the Test Method

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Ref.: PSS SB21

# SB31

## Product Specification Sheet

SB31 is an Ultra-High Molecular Weight Polyethylene fiber based composite laminate for low weight soft armor applications. A roll of product consists of two single layers of unidirectional sheet cross plied at 90 degrees to each other, consolidated with a rubber based matrix and covered with a protective film.

Property	Test Method	Unit (Metric) <sup>1</sup>	Unit (Imperial)
Roll length <sup>2,3</sup>	DTM LP060	≥ 200 m	≥ 219 yards
Roll width <sup>3</sup>	DTM LP199	≥ 1,60 m	≥ 63 inch
Areal density	DTM LP152	126 - 138 g/m <sup>2</sup>	3,72 - 4,07 oz/yd <sup>2</sup>
Spot defects <sup>4</sup>	DTM LP156	≤ 15 per roll	≤ 15 per roll

<sup>1</sup> Metric units are leading throughout this document

<sup>2</sup> Net length is excluding spot defect compensation

<sup>3</sup> In case of a non-full roll length or width, the dimensions are specified in the box information sheet, supplied with every box

<sup>4</sup> Spot defect definitions are given in the Test Method

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Ref.: PSS SB31



# Product Specification Sheet

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## BT10

### Composition

Dyneema® BT hard ballistic protection materials are woven and laminated sheets made from Dyneema® Ultra High Molecular Weight Polyethylene (UHMWPE) tape forming a continuous roll. The tapes are arranged in a woven structure of 0/90 degrees giving the product a checkerboard appearance.

### Product specification (SI units are leading throughout this specification document)

- Length\* full roll\*\*  $\geq 150\text{m}$  ( $\geq 164$  yards)
- Width full roll\*\*  $\geq 1,60\text{m} \pm 0,4 \text{ cm}$  ( $\geq 63 \text{ inch} \pm 0,16 \text{ inch}$ )
- Areal density  $168 \text{ g/m}^2 \pm 12 \text{ g/m}^2$  ( $4,95 \pm 0,35 \text{ oz/yd}^2$ )
- Visual defects  $\leq 15$  per roll

\* Gross length excluding the visual defect spot compensation.

\*\* In case of a non full roll length or width, the dimensions are specified in the box information sheet, supplied with every box.

### Visual defects

Dyneema® BT hard ballistic protection materials can contain minor visual defects. When a visual defect is found to be greater than the allowable dimensions listed below, it will be clearly marked with a bright colored sticker and compensated with 20 cm (7,87 inch) of additional material per visual defect.

### Allowable visual defect dimensions

Defects observed count as a visual defect when they exceed both width and length dimension indicated per bullet point below (where the width and length are defined in reference to the running direction of the roll length):

- Gaps in Length Direction      Width > 4,0 mm (> 0,16 inch)      Length > 20,0 cm (> 7,87 inch)
- Gaps in Width Direction      Width > 6,0 mm (> 0,24 inch)      Length > 6,0 cm (> 2,36 inch)
- Consolidation Failure      An area with no adhesion between the tape layers with a length > 10 cm (> 3,94 inch)
- Contamination      Foreign material or PE melts > 25 x 25 mm. (> 1 x 1 inch)
- Splices      Maximum of two adhesive tape splices per roll.

The maximum size of a visual defect in the length direction is 21 cm (8,3 inch). Such defects can be present up to the maximum number as defined above in this document.

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Dyneema® BT is suitable for use in anti ballistic/ protective applications.

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Ref.: LP57



# Product Specification Sheet

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## BT10

### Life Time Expectancy

BT10 is expected to preserve its quality for a period of at least 10 years during storage\*\*\* from the date of delivery, provided that the material:

- is stored under dry conditions at normal ambient temperature;
- has not been subjected to peak temperatures exceeding 90°C;
- is protected against long-term direct exposure to sunlight;
- is not exposed to unusual wear and tear.

*\*\*\*Storage means the period of time during which the material leaves the DSM facility until any subsequent processing applied by the converter.*

The lifetime expectation is derived from accelerated aging data, using acceleration factors typical to the material and assuming no wear or tear. If the material is exposed to more extreme conditions and unusual wear and tear, it may have shorter life time expectancy.

Most of the actual longer term accelerated and prolonged storage evaluations have been performed on a specific prototype woven tape construction. There are no reasons to assume a different long-term behavior for other Dyneema® BT materials for hard ballistic applications. The relation between aging and the ballistic performance has been assessed using the 9 mm FMJ bullet in a STANAG 2920, V50 rating. Other threats and different target constructions might give deviating results.

### DSM Dyneema Reference Documents

- The areal density is measured according DSM Dyneema Test Method, LP152;
- The visual defects are determined according to the DSM Dyneema Inspection Method, LP156;
- The length is determined according to the DSM Dyneema Test Method, LP60;
- The width is determined according to the DSM Dyneema Test Method, LP199;
- The handling risks of the material are explained in the Safety Data Sheet, LP245.

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