

TEIJIN

Human Chemistry, Human Solutions



Ballistics material handbook

Twaron[®]

The power of Aramid

Yarn List

Linear Density	Filaments	Twaron-Type	Strength at Break	Tenacity at Break	Elongation at Break	Chord Modulus
Dtex (effective)	No.		N	mN/tex	%	GPa
420 (415)	500	2040 Microfilament	105	2.350	3.5	91
550 (570)	500	2040 Microfilament	135	2.350	3.45	91
840 (860)	1000	2000 Microfilament	215	2.500	3.50	92
930 (960)	1000	2040 Microfilament	225	2.350	3.45	89
1100 (1135)	1000	2040 Microfilament	267	2.350	3.45	91
1680 (1640)	1000	2000 or 2040	385	2.350	3.45	91
3360 (3460)	2000	1000	688	1.990	3.70	67
3360 (3280)	2000	2000	770	2.350	3.45	91

Spin-finish content	Type 2000/2040: 0.7%	Type 1000: 0.8%
Tube length x diameter (mm)	290 x 94	216 x 94
Winding height/stroke (mm)	260	192
Packing (bobbins x kg)	≤ 1100 dtex	90 x 4.5
	1680 dtex	54 x 9
	3360 dtex	48 x 10
		52 x 9.2
		52 x 9.6

Twaron ballistic yarns

The history of protecting man against weapons goes back to ancient times. For hundreds of years, metal materials have been used not only for body armor but also for the protection of larger objects such as vehicles, providing what is called 'hard protection'. However, it was only a few decades ago, at the end of WWII, when softer constructions in the form of ballistic nylon vests first began appearing. But these vests could not come close to offering the present level of ballistic protection afforded by Twaron para-aramid filament yarns and the fabrics that can be made from them.

R&D efforts at Teijin Aramid, combined with tens of thousands of empirical evaluations have made this extraordinary level of ballistic protection possible. Twaron high-tenacity (CT) microfilament yarns represent a milestone in the efforts to produce high performing soft ballistic protection gear. This development of Teijin Aramid has allowed the creation of ballistic fabrics offering an even higher level of protection. This is due to the yarns' unique absorption of the kinetic energy caused by intruding projectiles. The myriads of nearly invisible filaments increase the "working" surface of the yarns, so the required stopping energy, or friction, can be obtained with less material.

The ultrafine filaments in the yarn also provide another benefit: the extraordinary softness that these yarns give to fabrics translates into a high level of comfort for the wearers of ballistic protection vests manufactured from such fabrics.

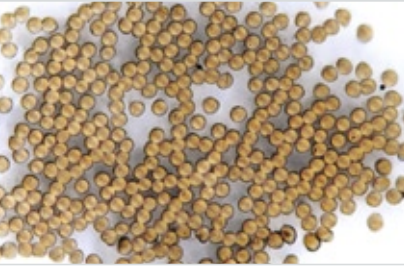
What's more, countless weaving tests on various creels, warping machines and different weaving machines have been carried out to ensure the optimum processability of Twaron, so it's no wonder that para-aramid ballistic filament yarns from Teijin Aramid have come to dominate the global markets.



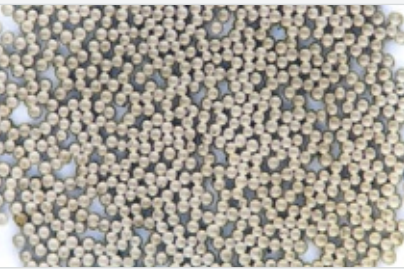
Twaron®

The power of Aramid

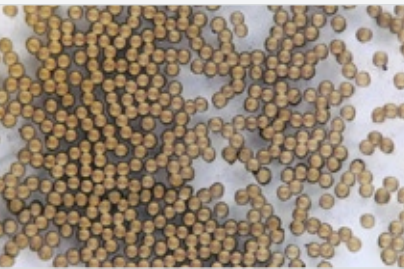
Twaron yarn cross sections



550 dtex



840 dtex



930 dtex



1100 dtex



1680 dtex



3360 dtex

In the ballistic protection materials segment, Teijin Aramid supplies high-tenacity microfilament yarns (with counts of 420, 550, 840, 930 and 1100dtex) which are used all over the world to provide the highest protection/comfort ratio for ballistic fabric constructions.

The high-tenacity Twaron filament yarns offer a high protection/economy ratio for various ballistic protection items within both soft and hard (including composite) applications.

The Twaron standard-tenacity fibers provide a perfect balance of performance and economy, and are an attractive alternative for numerous up-armoring projects within the hard-ballistic protection market.

Compared with other ballistic protection materials, Twaron para-aramid filament yarns excel in chemical stability, thermal stability and resistance to various aggressive environments.

The superb quality of all Twaron para-aramid ballistic filament yarns starts at the very beginning – with the basic chemistry used at the birthplace of Twaron in Delfzijl, the Netherlands. Here, the monomeric (and later the polymeric) basic materials for Twaron yarns are produced in chemical processes that meet the most stringent quality requirements to generate the highest value possible.

Our spinning facilities, as well as the polymer production facilities, comply with ISO 9001 and ISO 14.001 standards. Multiple quality controls of the Twaron production are performed daily, not only to guarantee the high performance and reliability of our products, but also to keep our promise to our customers: 'Perfect protection for safety and satisfaction.'

Twaron ballistic yarns – an overview

Twaron yarn type	Dtex	Key attributes	Primary applications
Twaron CT - high-tenacity microfilament	<ul style="list-style-type: none"> • 420 • 550 • 840 • 930 • 1100 	<ul style="list-style-type: none"> • Highest protection/comfort ratio • Light weight • High comfort 	<ul style="list-style-type: none"> • Soft protection
Twaron CT - high-tenacity	<ul style="list-style-type: none"> • 1680 • 3360 	<ul style="list-style-type: none"> • High protection/cost ratio • Standard weight • Good comfort 	<ul style="list-style-type: none"> • Soft protection • Hard protection
Twaron T - standard-tenacity	<ul style="list-style-type: none"> • 1680 • 3360 	<ul style="list-style-type: none"> • Balance between performance and cost efficiency 	<ul style="list-style-type: none"> • Hard protection

Twaron ballistic fabrics

Whenever the combination of high functionality, comfort and economy is required, you will find advanced para-aramid Twaron yarns being used in sophisticated fabric constructions tailored for specific end uses. In general, ballistic threats emanate either from bullets or fragments. Bullets can be defined as projectiles of various shapes and consistencies shot from weapons such as pistols, revolvers and rifles. Fragments, on the other hand, can originate from explosions (e.g., grenade detonations) or as pellets from shotguns. The manifold kinetic characteristics and deformation behaviors of such a broad range of bullets and fragments mean that different stopping mechanisms are required.

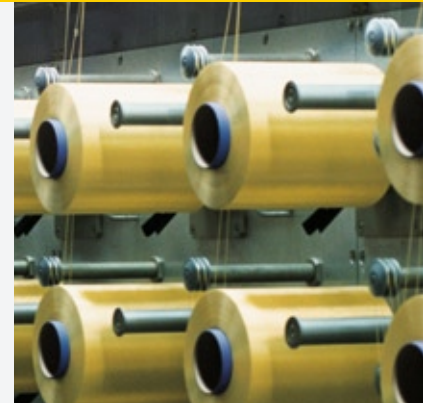
Soft-core (e.g., lead) bullets can be stopped with soft panels, i.e., textile fabrics layered on top of one another. However, specifications today often have to cover different types of bullets with different physical characteristics. Some of these require a customized and dedicated textile solution. Thanks to the high flexibility and wearing comfort that is possible today, such solutions are mainly used in body armor applications.

Hard-core (AP) ammunition is fragmented by steel or ceramic plates, and these fragments are then “caught” by resin-impregnated textile layers. While these hard plates can be used in body armor, they are mainly employed for vehicle and other hard-protection purposes.

The available Twaron fabric styles are designated with the codes CT (high tenacity) or T (standard tenacity), followed by a 3-digit number. This classification, used all over the world, is applied by high-quality weavers that are selected, authorized and approved by Teijin Aramid.

Most current Twaron ballistic materials used for personal protection are woven, mainly for the following reasons:

- Fabrics offer very good stability, as well as flexibility
- Fabrics are easy to handle, to cut and to process into finished product
- Fabrics can be finished to be water-repellent, making them superior to other materials when exposed to moisture
- On ballistic impact, threads are not pulled out or pushed aside
- The required production technology is widely available
- A matrix can be easily applied to a fabric, allowing the use of laminates for even higher levels of protection if required.



A wide variety of solutions

The range of ballistic fabrics covers different key attributes and characteristics:

CT 612

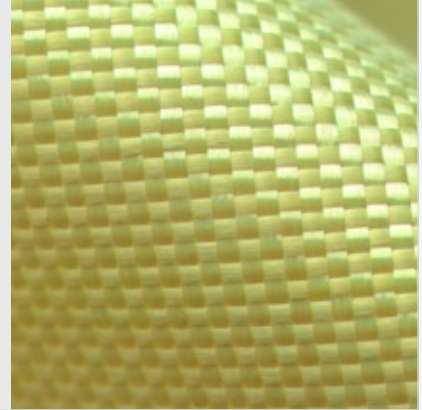
550 dtex

Primary application

Body armor

Key attributes/characteristics

- 125 g/m² ballistic fabric, based on one of the thinnest yarns ever made in the para-aramid spinning process
- Dedicated to providing maximum protection against bullets and fragments
- Successfully used in military vests, providing a lightweight and comfortable solution
- Available in Water Repellent Treated (WRT) finish or loom state



CT 704

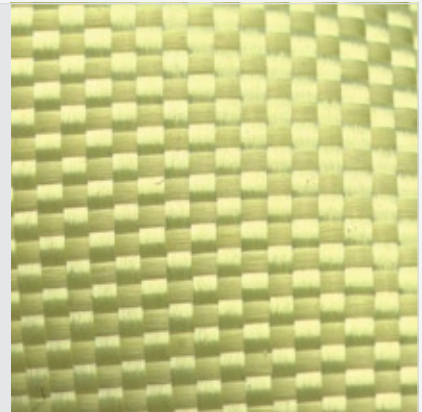
840 dtex

Primary application

Body armor

Key attributes/characteristics

- Based on one of the finest filament titers ever made in the para-aramid spinning process
- Dedicated to providing maximum protection against very small fragments
- The 180 g/m² also exhibits a bullet protection level that is very similar to that of Twaron CT 709



CT 709

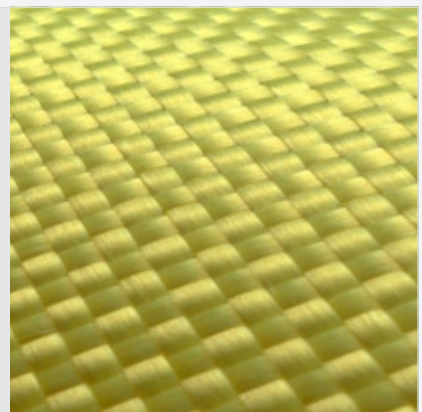
930 dtex

Primary application

Body armor

Key attributes/characteristics

- 200g/m² ballistic fabric, based on unique Twaron microfilament yarn
- Excellent ballistic protection combined with a high level of comfort
- Good cost/performance ratio
- Proven product, used by countless police departments around the world
- Enables the production of seamless ballistic packages providing the wearer with a surprising freedom of movement combined with high ballistic protection
- Particularly suitable for body armor vests for women
- Available in Water Repellent Treated (WRT) finish or loom state



CT 714

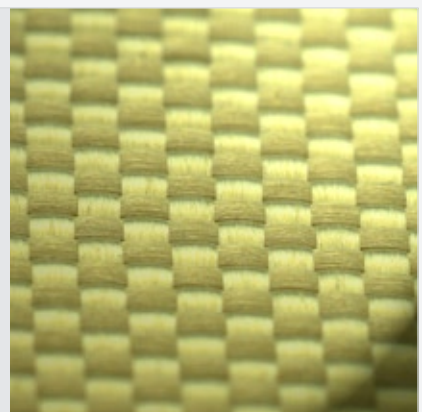
1100 dtex

Primary application

Body armor

Key attributes/characteristics

- 190 g/m², plain-woven fabric based on first microfilament fiber type
- Excellent fragmentation protection
- Used for fragmentation jackets by most of the armed forces around the world
- Good protection against specific types of projectiles
- Cost attractive solution
- Available in Water Repellent Treated (WRT) finish or loom state



CT 716

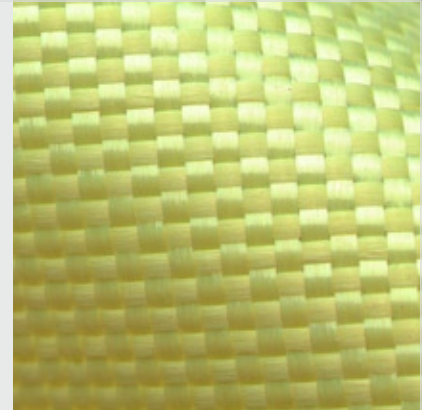
1100 dtex

Primary application

Body armor

Key attributes/characteristics

- 280 g/m², plain-woven fabric based on high-tenacity (CT) Twaron yarn
- This tightly woven fabric offers very good ballistic protection against projectiles combined with advantageous blunt trauma behavior
- Reflects the weight/performance ratio prevalent in the late 1980s



CT 736

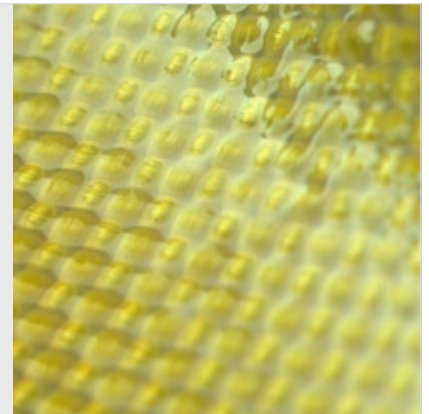
1680 dtex

Primary application

Helmets

Key attributes/characteristics

- 410 g/m² ballistic fabric
- Used for the production of modern, state-of-the-art ballistic helmets
- Typically used in mine boots sandwich constructions
- Available in loom state or scoured as standard
- Good processability with different resin systems



T717

1680 dtex

Primary application

Body armor - where the weight of the ballistic pack is not a priority

Key attributes/characteristics

- Plain-woven fabric based on standard tenacity (T) Twaron yarn
- Designed for economy-driven ballistic protection solutions requiring good projectile and fragmentation resistance



T750

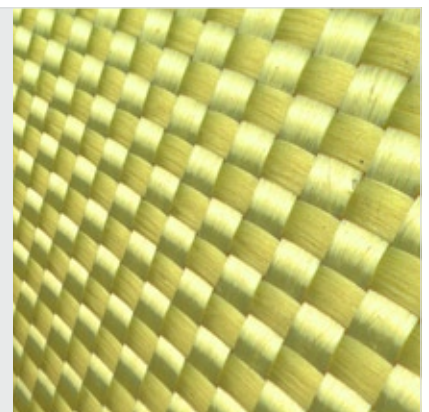
3360 dtex

Primary application

Hard Ballistics

Key attributes/characteristics

- 460 g/m², plain-woven fabric
- Widely used in hard ballistic applications
- Typically used in spall-liners
- Furthermore, numerous helmet shells are made out of this fabric (wet process)
- Typical finish used: scoured



T 760

3360 dtex

Primary application

Hard Ballistics

Key attributes/characteristics

- 635 g/m² ballistic fabric
- Heavy and very flexible fabric for up-armouring of vehicles
- Excellent shaping possible, therefore suitable for manufacturing process



Microflex

550 dtex

Primary application

Body armor

Key attributes/characteristics

- 220 g/m² ballistic fabric, dedicated to providing maximum protection to correctional officers
- A patented puncture resistant fabric made from Twaron microfilament yarn, woven to stringent specifications and finished by a proprietary process yielding unsurpassed performance against the NIJ 0115 engineered spike
- Microflex outperforms existing puncture resistant fabric technology by offering a softer and more comfortable solution than current technology
- The most wearable, cost effective solution available to correction officers faced with the daily threat of attack
- The extraordinary NIJ Spike Level 3 (E2) 65 Joule strike energy is easily defeated with Twaron Microflex in a lightweight concealable vest construction



Felt No.9

stable fiber 1.6

Primary application

Body armor

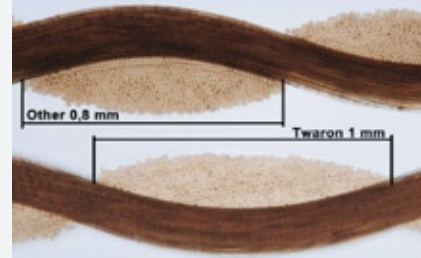
Key attributes/characteristics

- Based on Twaron microfilament staple fiber
- Very soft textile surface, offering a degree of ballistic protection combined with additional mechanical properties and comfort effects
- Surfaces of 350 g/m² aerial density proved optimally effective for different ballistic constructions in improving the stopping behaviour of specific ammunition or in creating an excellent intermediate layer for stab protection
- Contributing functionality into stab protection

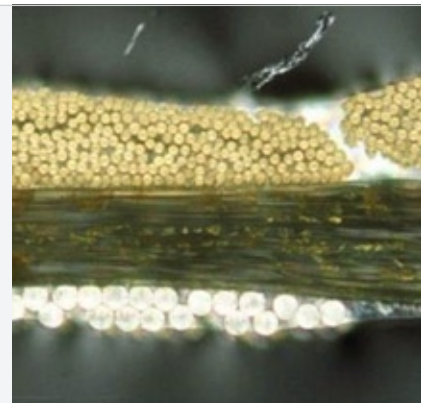


Cross sections

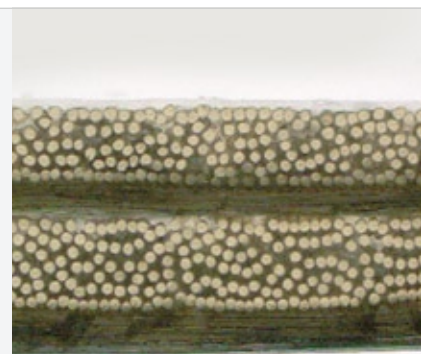
Cross sections of fabrics (200g/m²) containing standard aramid yarn (upper part) and Twaron microfilament yarn (lower part)



Cross section of LFT SB1 fabric containing Twaron microfilament yarn.



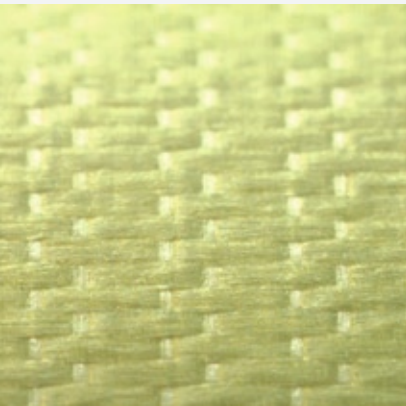
Cross section of LFT GF4 unidirectional material. Fourfold structure (shield).



Twaron LFT SB1



The past years have brought many improvements in ballistic protection materials. Teijin Aramid's approach, combining low-crimp woven products with low resin content, resulted in the launch of Twaron Laminated Fabric Technology SB1 (LFT SB1) – a very flexible and thin laminate comprising two fabric layers sandwiched with three layers of ultra-thin PE film. The two fabrics are made from Twaron para-aramid microfilament yarn running in one direction and very fine PES threads running in a second direction. This fabric construction system does not allow an intruding bullet to push the yarns apart, a distinct advantage over typical shield materials.



For the user, this translates into significantly improved bullet resistance compared with traditional ballistic fabrics. The same level of ballistic protection can be achieved with less material, increasing comfort for the wearer. To meet the requirements of certain standards (e.g., TR 2003, NIJ 01.01.04), the weight of the entire ballistic pack can be reduced by as much as 25%.

The reduction of the mass in the final ballistic pack is achieved by a lower number of Twaron LFT SB1 layers. This results in a thin protecting pack, contributing to greater freedom of movement.

Thanks to both the combination of materials and a new, unique laminating technology, a soft surface has been created that feels like natural skin. Furthermore, Twaron LFT SB1 laminate offers a relatively high permeability, comparable with tight-woven fabrics, a feature that positively contributes to the sweat management of the wearer.

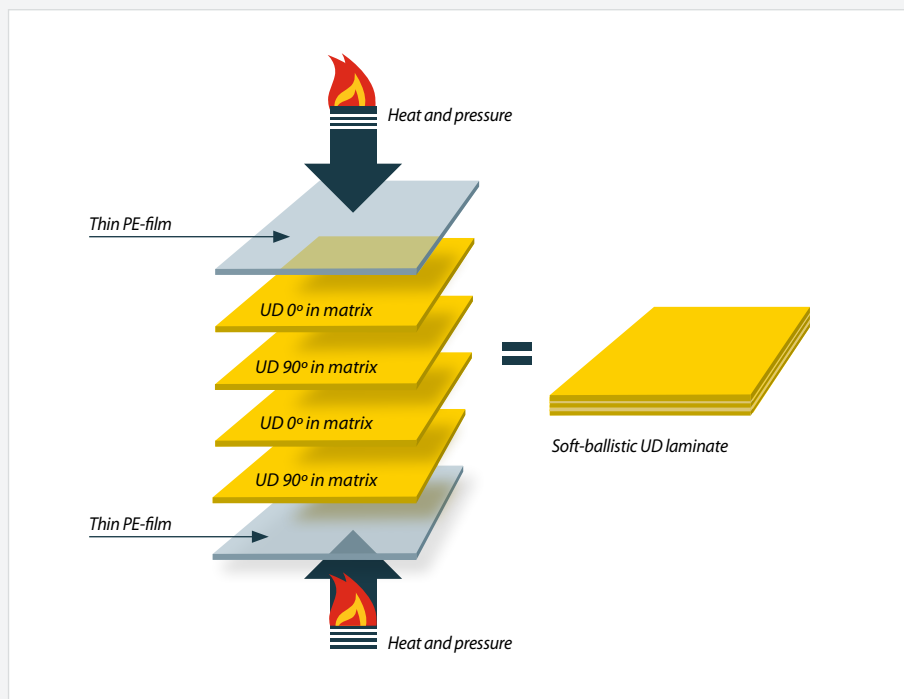
These sandwiched low-crimp woven constructions will, without a doubt, be the future of ballistic protective fabrics used in high-end body armor.

Twaron LFT GF

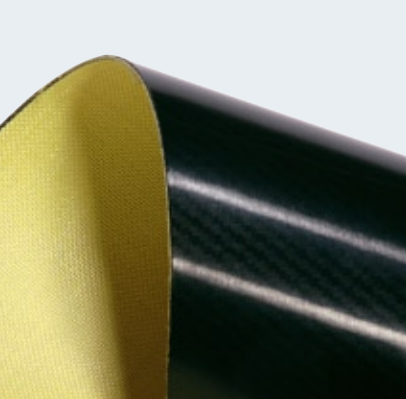
The idea of creating no-crimp materials to make full use of fiber tenacity led to the development of unidirectional products (UD). In a cross-plying process, lines of thousands of Twaron filaments merge in 0° and 90° directions. The materials are then laminated in either twofold (GF2) or fourfold (GF4) with thin PE films to achieve good performance, low weight and reasonable costs for ballistic protection requirements. Standard lead-core bullets fired by small arms weapons (e.g., hand guns) are the typical threat against which LFT GF materials offer protection.

Compared with other shields, the high proportion of Twaron para-aramid fibers (microfilament in GF) in Twaron LFT GF materials reduces the disadvantages typical to thermoplastic shield constructions.

However, it is the complementary functionality of the LFT GF materials that is becoming increasingly prominent in the modern world of ballistic protection engineering. The rising number of modified threat specifications that combine typical and non-typical bullets call for new and more sophisticated “hybrid” solutions. Combinations of fabrics, laminates, shields and coated materials, all based on Twaron ballistic fibers, are likely to become the state-of-the-art response to the challenging protection demands of the future.



Twaron LFT-AT/AT Flex



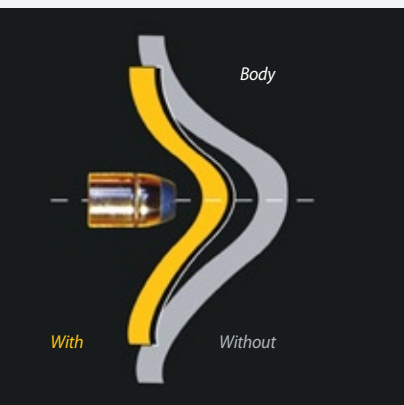
The primary objective of a ballistic pack is clear – to stop the bullet. But in a number of situations blunt trauma remains an obvious and unwelcome problem.

In light of this, Teijin Aramid Ballistic Engineering has developed a new material permitting an effective reduction of the impact depth. Combining Curv® (made by Propex Fabrics), an extraordinary hit-resistant polypropylene woven surface, with Twaron CT 707 high-tenacity fabric, a unique material was created.

This material is light, thin and has sufficient flexibility to reduce blunt trauma behind the ballistic pack.

Depending on the type of bullet and its speed, one or two layers of Twaron LFT-AT/AT Flex may lessen trauma by 30% to 60% – even near the edges of the target. Environmental and functional stability, combined with easy handling, are further benefits of the new material.

Adding only a few hundred grams per square meter to the ballistic pack, Twaron LFT AT/AT Flex offers the optimum combination of weight, volume and performance currently available.



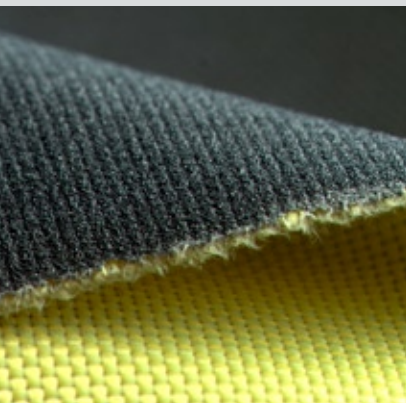
Twaron Sideguard®

In the past, thickly layered and quilted ballistic fabrics provided protection against bullets and shrapnel (hot weapons), but not against blades, knives and needles (cold weapons). Specially coated, layered fabrics – the next generation of laminate technology – was the way to go, to prevent both hot and cold weapons from penetrating. However there was an increased risk of the bullet punching through the first few laminate layers, hitting the tough surface of each successive layer at such an extreme angle that it will be deflected back toward the outside of the vest. To solve this problem of deflection, Teijin Aramid introduced Twaron Sideguard.

Twaron Sideguard is a cover pulled over the vest's laminate layers that can catch a bullet as it exits the vest. Twaron Sideguard, being a knitted fabric, is flexible enough to not have the residual energy of the bullet make it burst through the fabric. The knitted fabric gives Twaron Sideguard the ability to stretch, enabling the fabric to safely absorb and lead off the bullet's latent energy, bringing it to a standstill. To add extra protection, Teijin Aramid's unique textile-manufacturing software designs Twaron Sideguard into seamless structures of virtually any shape. Twaron Sideguard is the first and only knitted structure offering ballistic protection on the market today.



Twaron for stabbing protection



Twaron SRM®

Along with the need for protection against ballistic impact, protection against attacks by sharp and pointed weapons has become a matter of increasing priority. In more and more countries, police officers are facing the threat of a wide range of stabbing weapons.

Against this background, Teijin Aramid has developed Twaron SRM, a unique material providing superior protection against a broad array of weapons. Twaron SRM incorporates Twaron CT microfilament fabric with a functional silicon carbide coating that is bonded by a special matrix system. The functional coating absorbs and dulls the thrust from the blade or needle just as if it were solid rock, and the energy from the impact is then absorbed by the high-impact resistance and tenacity of the para-aramid yarn in the fabric underneath. Thanks to the special matrix, the material is flexible and almost as soft as a non-coated fabric. This functionality is achieved by having a density that is only one-quarter of the standard steel used in stab protection.

Twaron ladies' vest

While the advancement of aramid yarns and fabrics has resulted in an ever-improving level of protection performance, progress on the comfort side failed for a long time to acknowledge the special needs of female wearers. Although the number of female officers has been rising significantly in Europe and North America, these women have to rely, in general, on body armor designed for the male physique rather than the comfort requirements of the female body.

To meet this demand, Teijin Aramid and Triumph International, a global leader in the manufacture of underwear and lingerie, devised a unique manufacturing concept offering the first body armor for women that is both comfortable to wear and able to offer maximum ballistic protection.

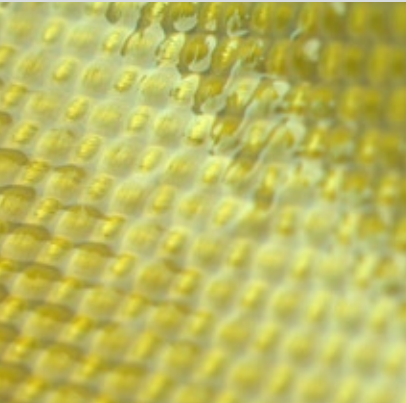
In a molding process performed at Triumph, the CT709 fabric style has proved to be best suited for the production of a ballistic pack that comprises several layers shaped to match the female bust. The method used is a kind of deep drawing process, where the Twaron fabric is molded with the aid of pressure and heat. The final product requires neither additional finishing operations nor the use of chemicals to fix the deep drawn shape. Subsequently, the molded fabric layers are placed on top of each other to obtain a garment part, then joined by a base seam, e.g., in the middle of the panel.

There are currently five molds available, each a different volume size, and these can be combined with the various vest sizes and design patterns. In this way, this system allows for as much variation as possible in order to match each woman's individual torso shape. The result of this is a comfort level for the wearer unparalleled by any other female ballistic protection vest system on the market.

The product, as well as the process support for its manufacture, is available only from Teijin Aramid.



Twaron preregs for helmets and hard ballistic solutions



The monumental success of composite ballistic protection helmets in modern armies started with the use in their manufacture of plain-woven 460 g/m² fabric. Today, Twaron T750 and Twaron CT 736 are both very basic fabric styles for this kind of light composite up-armor. Although CT 736 is the more advanced fabric style and is widely used, both fabric styles can be used either neat – in what is called the ‘wet process’ – or impregnated with PVB resin for composite shell applications so as to offer the highest levels of performance. Impregnated Twaron fabrics are also part of the range of Teijin Aramid ballistic protection materials.

Twaron T750 is the ideal fabric for a variety of products for hard ballistic protection, including spall liners, multilayer laminates and lightweight, high-tenacity backings, as well as supporting steel, ceramics and various other front materials in complex composite solutions.

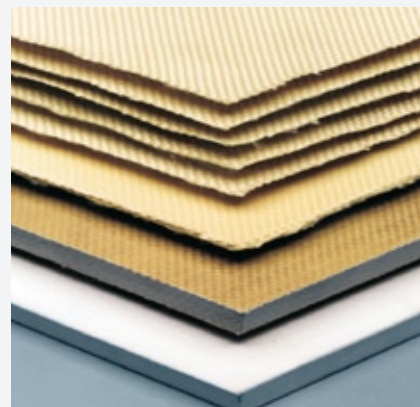
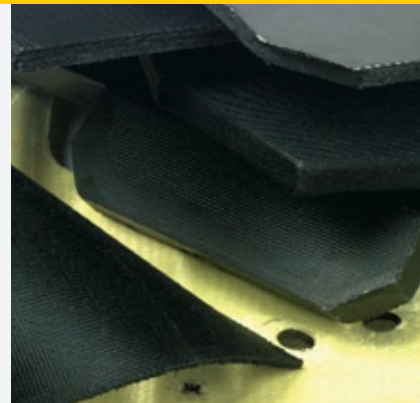
Twaron in hard ballistic protection

A wide range of materials are used for different hard ballistic applications. These materials include ceramics, special metal alloys, honeycomb structures and even simple car-body steel combined with Twaron fabric. Thousands of firing and blasting tests performed by our engineers have established an enormous body of knowledge and experience about the application of Twaron materials, making our staff highly valued professional partners for the up-armor industry.

Thousands of light and heavy military vehicles have add-on armor systems for higher protection levels, as well as interior spall liner applications for better protection against fragments. Numerous airplane cockpits protect their pilots against hits or high-energy AP ammunition, thanks to the unique behavior of the Twaron/Ceramic composites in their up-armored plane bodies. Navy frigates and fast patrol boats significantly increase their ballistic safety by having parts of their hulls manufactured with Twaron laminates. Thousands of security cars all over the world rely on dedicated lightweight composite solutions to protect drivers and passengers against a wide range of threats from bullets, fragments and blasts.

However, it is not only vehicle or object protection, where Twaron-based composites play a key role. Police officers around the world count on their light ballistic shields containing Twaron materials to offer them the highest ballistic protection possible against rioters, criminals or terrorist attacks. Effective personal protection is unthinkable without light ceramic/Twaron panels capable of withstanding multiple hits of high-energy AP ammunition. To meet personal protection needs, various high-performing ballistic inserts can be supplied that comply with the requirements of different international standards.

In all these ballistic protection applications, you will find products that originate from Teijin Aramid. These products include Twaron fabrics CT 736, CT 737, T 750, T 751 and T 760; multilayer rubberized Twaron laminates such as Twaron LFT HB1; and even very complex composites of different materials bonded together with Twaron. Applied in accordance with the recommendations of our engineering department, they provide optimum ballistic protection.



Fabric List

Style	Linear Density [dtex _{nom}]	Twaron-Type	Weave	Sett [per 10 cm]		Areal Density [g/m ²]	Thickness [mm]	Breaking Strength [Minimum; N/5cm]	
				Warp	Weft			Warp	Weft
CT 612	550 f 500	2040	Plain	110	110	125	0.20	5.000	5.200
CT 613	550 f 500	2040	Plain	123	123	135	0.20	5.000	5.500
CT 704	840 f 1000	2000	Plain	107	107	180	0.30	7.800	8.200
CT 706	840 f 1000	2000	Plain	126	126	215	0.31	9.200	9.700
CT 707	930 f 1000	2040	Plain	85	85	160	0.25	6.500	7.000
CT 709	930 f 1000	2040	Plain	105	105	200	0.30	8.000	8.500
CT 714	1100 f 1000	2040	Plain	85	85	190	0.30	7.700	8.200
CT 716	1100 f 1000	2040	Plain	122	122	280	0.40	10.500	11.100
CT 732	1680 f 1000	2000	Plain	68	68	220	0.34	8.300	8.900
CT 736	1680 f 1000	2000	Basket 2x2	127	127	410	0.62	15.500	16.600
CT 737	1680 f 1000	2000	Twill 2x2 Z	127	127	410	0.60	15.500	16.600
CT 747	3360 f 2000	2000	Plain	63	63	410	0.62	15.500	16.600
T 717	1680 f 1000	1040	Plain	82	82	280	0.43	10.500	11.000
T 730	1680 f 1000	1000	Plain	78	78	260	0.40	9.400	10.000
T 750	3360 f 2000	1000	Plain	67	67	460	0.65	16.200	17.400
T 751	3360 f 2000	1000	Plain	45	45	300	0.53	10.900	11.700
T 760	3360 f 2000	1000	Twill 4x4	92	92	635	1.05	22.000	23.500

Depending on performance requirements fabrics may be used woven, scoured or scoured and Water Repellent Treated (WRT- soft or hard)

Ballistic laminates (LFT) / coated fabrics

Style	Main Application	Linear Density [dtex _{nom}]	Twaron-Type	Total weight [g/m ²]	Construction
SB1	Bullet resistant vests	930 f1000	2040	220	2 layers Twaron woven fabric + 3 layers thermoplastic film
AT	Anti-trauma	930 f1000	2040	780	Laminate of CT 707 woven Twaron fabric + PP-Fabrics
AT Flex	Anti-trauma	930 f1000	2040	490	Laminate of CT 707 woven Twaron fabric + PP-Fabrics
GF4	Bullet resistant vests	1100 f1000	2000	234	4 unidirectional Twaron layers laminated + 2 PE-Films
Microflex	Spike resistant vests	550 f500	2040	220	Woven fabric with special densification treatment
SRM	Stab resistant vests	930 f1000	2040	430	CT 709 woven Twaron fabric + silicon carbide coating

More information on Teijin Aramid's ballistic solutions can be found in the dedicated Body Armor, Hard Ballistics and Helmets leaflets or through our Sales Department via ballistics@teijinaramid.com.

TEIJIN

About Teijin Aramid

We are Teijin Aramid, a subsidiary of the Teijin Group with a passion for aramid. Our commitment both to our products and to our customers has made us a global leader in aramids. Wherever strength, safety, heat or flame resistance, low weight or sustainability is required, you will find our Twaron®, Sulfron®, Teijinconex® or Technora®. Our products are used worldwide in many different applications and markets, including automotive, ballistic protection, marine, civil engineering, protective clothing, optical fiber cables, and oil & gas. With our four high performance aramids – produced at our plants in The Netherlands and Japan – we offer the widest range of products. And, with unrivalled expertise and experience we are able to continuously work on further innovations. Often in cooperation with customers and partners through our worldwide sales and marketing organization. That's the power of aramid. If you would like to learn more about the world of aramid or to exchange ideas on developing new solutions, please go to:

www.teijinaramid.com or e-mail us at: ballistics@teijinaramid.com

Twaron®

The power of Aramid