Super Vest! Is this the Next Generation of Soft Body Armor?

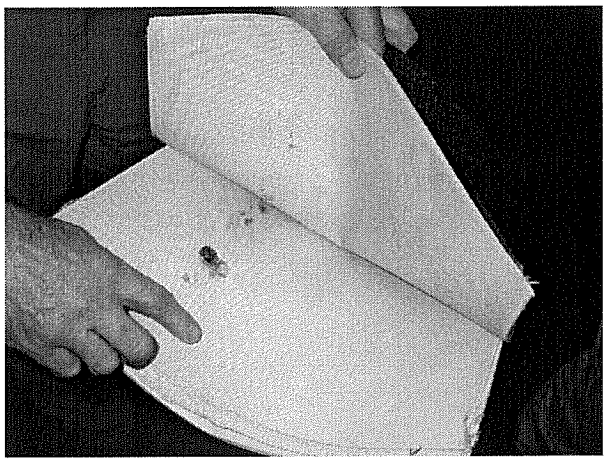
by John Higgs

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Martin Beale held up his thumb and forefinger about an inch apart and told me, "The technological advancement of para-aramid fibers has progressed about this far in the last forty years. We've just taken it to the next planet." Beale is the head of Praetorian Associates Ltd., a London based company that employs armed security guards in Iraq and other conflict zones around the world. Praetorian also offers a line of soft body armor using synthetic para-aramid material with brand names like Kevlar and Twaron that has been specially treated to be waterproof. The company reported an unexpected side effect of the waterproofing process: the treated para-aramid becomes fifty times stronger than "regular" para-aramid fibers.

Beale and I had arranged to meet at the 2005 Shooting Hunting Outdoors Trade Show (a.k.a. SHOT Show) in Las Vegas for him to give me a demonstration of this unique version of the venerable cut and abrasion resistant material that, if the claims of the manufacturer are true, will probably revolutionize the...

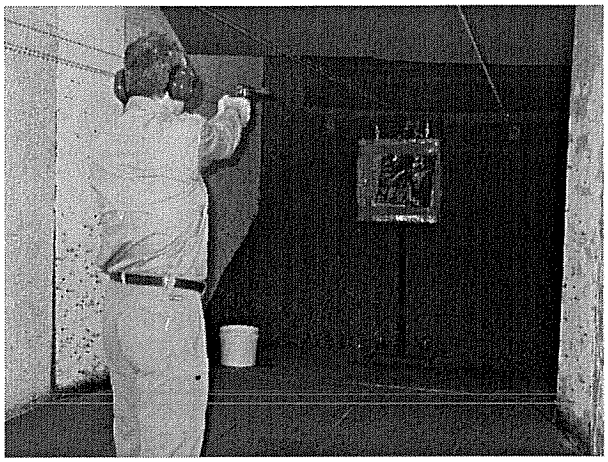
use of soft body armor by law enforcement officers and military personnel worldwide.



Soft Body Armor is what most people incorrectly refer to as a "Bullet Proof Vest". Bullet Resistant is a better term. Any vest can be penetrated if a sufficiently powerful bullet is used. Typical soft body armor, if designed to resist bullets, is not capable of stopping penetration by knives or other sharp objects. That requires a vest of a different construction. The vest worn by a police officer on patrol is probably designed to stop bullets rather than knives or needles, whereas a prison officer is more likely to be stabbed than shot, so his vest is constructed accordingly. Soldiers, on the other hand may face both threats, and a third too: high velocity shrapnel from exploding bombs and grenades.

Vests are built to meet varying standard threat levels as defined by the National Institute of Justice(NIJ): I, IIA, II, IIIA III, IV(See Table number two). So, when Martin Beale offered to demonstrate Praetorian's vest, utilizing specially treated para-aramid fibers that withstand not only bullets, but knives and bomb fragments too, I jumped at the chance. Bob Irwin, owner of The Gun Store in Las Vegas kindly made one of his indoor

ranges available to us for testing purposes, and representatives from two U.S. Army Special Forces groups were also invited to attend the live-fire demonstration. All shooting, and the stabbing demonstration, was done on one pack of the specially treated material.



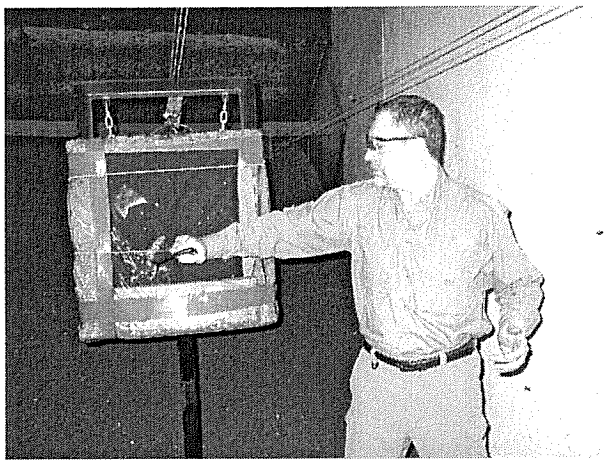
Instead of shooting into a complete vest, the test piece was configured to represent Level IIIA soft body armor. It comprised 22 separate layers of Praetorian's treated para-aramid material, approximately 16 inches wide by 16 inches long, in front of a dense foam backing material seven millimeters thick (0.275 inches), placed inside a black cordura pouch to simulate the external shell of a soft vest. The package was then attached with bungee cord to two packs of polyurethane foam rubber floor tiles several inches thick, of the type commonly found on workshop floors to prevent slipping. The floor tiles were used as a backing material behind the Cordura pouch in order to measure Blunt Force Trauma. Due to the timing of the demonstration, we were unable to obtain Plastalina Clay #1 (a type of modeling clay) which is recognized by the National Institute of Justice as the medium by which the amount of Blunt Force Trauma is recorded.

A blow to the human body can cause Blunt Force Trauma that ranges from mild bruising to severe damage to organs, resulting in death. Blunt force trauma can occur when soft body armor successfully PREVENTS a bullet from entering the body. But the kinetic energy from the bullet striking the body armor continues to move in the same direction as the bullet, through the body armor and into the body, disrupting fluid and internal organs in the same way as a blow to the torso from a fist or a baseball bat. Scientists measure the effects of kinetic energy imparted to the body by placing the soft body armor up against a slab of Plastalina Clay #1 before they fire a bullet at the body armor. The kinetic energy creates an indentation in the clay called a Backface Signature. NIJ Standards dictate that the acceptable level of blunt force trauma to the body may create a backface signature indentation in the clay not greater than 44 millimeters (1.73 inches) in depth. Polyurethane foam, like the backing material used in our demo, can also be used, like Plastalina Clay #1 to measure blunt force trauma.

Martin Beale began the demonstration by pouring water into the Cordura pouch that contained the treated material. The "regular" para-aramid fibers often used in other soft body armor would, at this point, be rendered less resistant by moisture to the impact of bullets. Moisture seems to act as a lubricant, making it more difficult for the para-aramid fibers to grab onto the bullet and slow it down. Beale fired a 9mm MP5 submachine gun full auto into the Praetorian armor. No rounds penetrated more than ten layers of the 22 layers in the pouch (See table number one). "Regular" soft body armor, even if dry, would not hold up very well to several rounds of burst fire 9mm. Generally, any soft vest will stop the first round or two, but the rest of the burst will pass right through the vest. It is important to note that all the rounds do not have to impact in exactly the same place when fired full auto, in order to penetrate the vest. Praetorian's treated material is slightly stiffer than sheets of regular para-aramid fibers and the individual sheets did not separate when hit with multiple rounds.

After each string of fire, the pouch was removed from the target stand and the 22 layers of treated material were counted in order to determine how many layers had been penetrated. Since most rounds impacted center of mass, the Praetorian armor was becoming weaker with each string of fire, but it did not allow any

rounds to pass all the way through (See Table Number One). The other notable demonstration was the twelve gauge lead slug which penetrated 13 layers and put a split in the back of the Cordura pouch. The slug was the only projectile to leave a backface signature in the rubber floor tile material behind the Cordura pouch, and created a shallow crater about a quarter inch deep. One other unfortunate side effect that can occur when rounds penetrate completely through "regular" soft body armor into the human body is something called Penciling. Penciling occurs when the para-aramid material is ripped into ribbons which are then dragged by the bullet into the wound channel created in the human body.



Praetorian's hard para-aramid Armor

The highest level of protection in soft body armor is Level IV. The usual method to achieve this has been for manufacturers to take a Level IIIA vest and sew pockets onto the front and back in which an armored steel or ceramic plate is inserted, adding a lot more weight for the wearer to carry. The Praetorian Hard Armor plate has been developed using the same material as their soft armor but with a different process which involves applying a resin to both sides of each sheet of para-aramid material and using pressure and heat to laminate the sheets together. In conjunction with ceramic material, this process also allows for the material to be formed into items like Ballistic Shields, or lighter-than-steel inserts for Level IV vests, that can defeat Armor Piercing AK47 rounds (7.62 x 39mm AP & API). According to Martin Beale, initial results from Afghanistan indicate the plates are stopping 5.56mm and 7.62 mm rounds at 200 meters. The standard army vest has pouches front and back to hold hard armor SAPI plates that weigh about 15LBS in total. The synthetic laminated Praetorian plate is lighter, although we didn't obtain precise information on the weight savings.

Stabbing Demonstration

This demonstration was conducted on the same test pack of Praetorian armor into which approximately 50 – 60 projectiles had already been fired. A backhanded, Filipino style knife stab was selected for its strong thrust. The Gunstore personnel took all three test knives right off the shelf for the demo (as they did with the ammunition used). First, a double edged spear point about nine inches long barely penetrated through the center of the soft armor with about a half inch sticking out the other side. The stab was made to the center of the area of the material that had taken all the rounds, so the demonstration was repeated on an area of the material that had not been shot. This time the knife did not penetrate all the way thru. Second, Martin Beale thrust a single edge blade into the material. It penetrated a couple of layers and bounced back out. In the third test, an AK47 bayonet with a single sharp edge was unable to penetrate any better than the other single edge blade. Unfortunately we did not have access to an ice pick or needles to test the resistance to those items.

On behalf of all of us who took part in the demonstration, I'd like to thank Bob Irwin, owner of The Gun Store, Inc. in Las Vegas, Nevada, who provided his indoor range and firearms, and Rafael Gutierrez and Dave Johnson who helped us set up and conduct the demonstration.

T&E

This demonstration was not meant to be a laboratory test, and therefore was not conducted under laboratory conditions. The observers at that demonstration all have extensive experience with soft body armor and the questions they asked, and observations they made, indicated that they liked what they saw. One of them told me, "I'm impressed. I don't think the body armor that I wear every day would work as well as this stuff does." In addition to stopping every type of round that is included in the Level IIIA standard, it stopped burst fire 9mm when wet, and stabbing weapons too. However, potential customers are advised to do their own research before purchasing body armor from any manufacturer.

SIDEBAR

Probably the most well known name in soft armor, Kevlar is the DuPont Company's brand name for a synthetic material constructed of para-aramid fibers that the company claims is five times stronger than the same weight of steel, while being lightweight, flexible and comfortable. It was invented by Stephanie Kwolek of the DuPont Company as a result of her research into high performance polymers, and patented by her in 1966. When this polymer is spun in the same way that a spider spins a web, the resulting commercial para-aramid fiber has tremendous strength, and is heat and cut resistant. Para-aramid fibers do not rust or corrode, and their strength is unaffected by immersion in water. When woven together, they form a good material for mooring lines and other underwater objects. However, unless specially waterproofed, para-aramid fiber's ability to stop bullets and other projectiles is degraded when wet. It was originally intended to replace the steel belts in tires, but is now used among many other applications, in the manufacture of load bearing cables for bridges, brake pads, and, of course, soft body armor.

TABLE Number One:

Range approx 6 yards. WEAPONS and AMMUNITION used in the test with penetration:

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Weapon and Ammunition and number of rounds fired	Layers of Kevlar penetrated
H&K MP5 submachine gun 9mm 115 grn FMJ (Full Auto burst)	10
Colt Mod 635 submachine gun 9mm 147 grn Speer Gold Dot JHP (Full Auto burst)	4-5
Ruger 9mm pistol 147 grn Speer Gold Dot JHP several rounds	4-5
1911 5 inch barrel .45ACP 230 grn FMJ 5 rounds	5
Ruger Redhawk 6 inch barrel .357 magnum Federal American Eagle 158 grn JSFP 6 rounds	10
Ruger Redhawk 7 1/2 inch barrel .44 Magnum 240grn JHP 6 rounds	10
12GA pump action shotgun 14 inch barrel 2 ¾ one oz slug distance 12 yards	13
Remington 9 pellet 2 ¾ oo buckshot distance 12 yards 00 buck	4-5

Table Number Two:

NIJ & PSDB & Praetorian
Certificate Levels comparison

Ballistics

NIJ	PSDB	PRAETORIAN
Level I .22 Long Rifle lead round 1050 fps & .38 Full metal Jacket 1024 fps Blunt trauma max 44mm	Not Applicable	Not Applicable
Level IIA 9mm FMJ round nose 1090 fps .40 Smith & Wesson FMJ 1024 fps Blunt trauma max 44mm	**HG1A** 9mm FMJ 1181 fps .357 Mag soft point 1263 fps Blunt trauma max 44mm	**HG1A** 9mm FMJ 1181 fps & 1428 fps Single & Burst fire .357 soft pt 1263 fps 1477 fps .44 Mag 1477 fps .45 860 fps Blunt trauma max 20mm
Level II 9mm FMJ round nose 1090 fps .357mm Magnum soft point 1263 fps Blunt trauma max 44mm	**HG1** 9mm FMJ 1090 fps .357 soft pt flt nose 1263 fps Blunt trauma max 25mm	**HG1** 9mm FMJ 1090 fps & 1427 fps Single & Burst fire .357 soft pt 1263 fps & 1476 fps .44 mag 1476 fps & .45 860 fps Blunt trauma max 15mm
Level IIIA 9mm FMJ round nose 1090 fps .44 magnum semi jack hollow pt 1477 fps Blunt trauma max 44mm	**HG2** 9mm FMJ 1090 fps .357 soft pt flt nse 1263 fps Blunt trauma max 25mm	**HG2** 9mm FMJ 1090 fps & 1427 fps Single & Burst fire .357 soft pt 1263 fps & 1476 fps .44mag 1476 fps & .45 860 fps Blunt trauma 13mm
Not Applicable	**SG1 (Plate)** 12 gauge 1oz 1427 fps Blunt trauma max 25mm	**HG2 (Soft Armour)** 12 gauge barrel length 343mm 1oz slug & double O Buck Blunt trauma max 25mm
Level III (Plate) 7.62 FMJ 2723 fps Blunt trauma max 44mm	**RF1 (Plate)** 7.62 FMJ 2723 fps Blunt trauma 25mm	**AK47(Plate)** 7.62 x 39 FMJ & Armour Piercing & Armour Piercing Incendiary (Russian, Chinese & Czech) Blunt Trauma 10mm
Level IV (Plate) .3 armour piercing 2851 fps Blunt trauma max 44mm	Not Applicable	Not Applicable

Knife & Spike

NIJ follow the PSDB Knife & Spike tests.

Level Knife 1 & Spike 1 tested 24 joules of energy
Level Knife 2 & Spike 2 tested 33 joules of energy
Level Knife 3 & Spike 3 tested 43 joules of energy

Praetorian Vest qualification = **HG1A/KR1 & SP1 – HG1/KR1/SP1 – HG2/KR2/SP2**

Tables provided by Praetorian Associates Ltd.

Author's Note: PSDB is the UK's Police Scientific Development Branch. Staffed by over 200 scientists and technicians, the PSDB supports The UK law enforcement community and British government departments and sets standards for such items as soft body armor in the same way that the National Institute of Justice does in the United States.

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