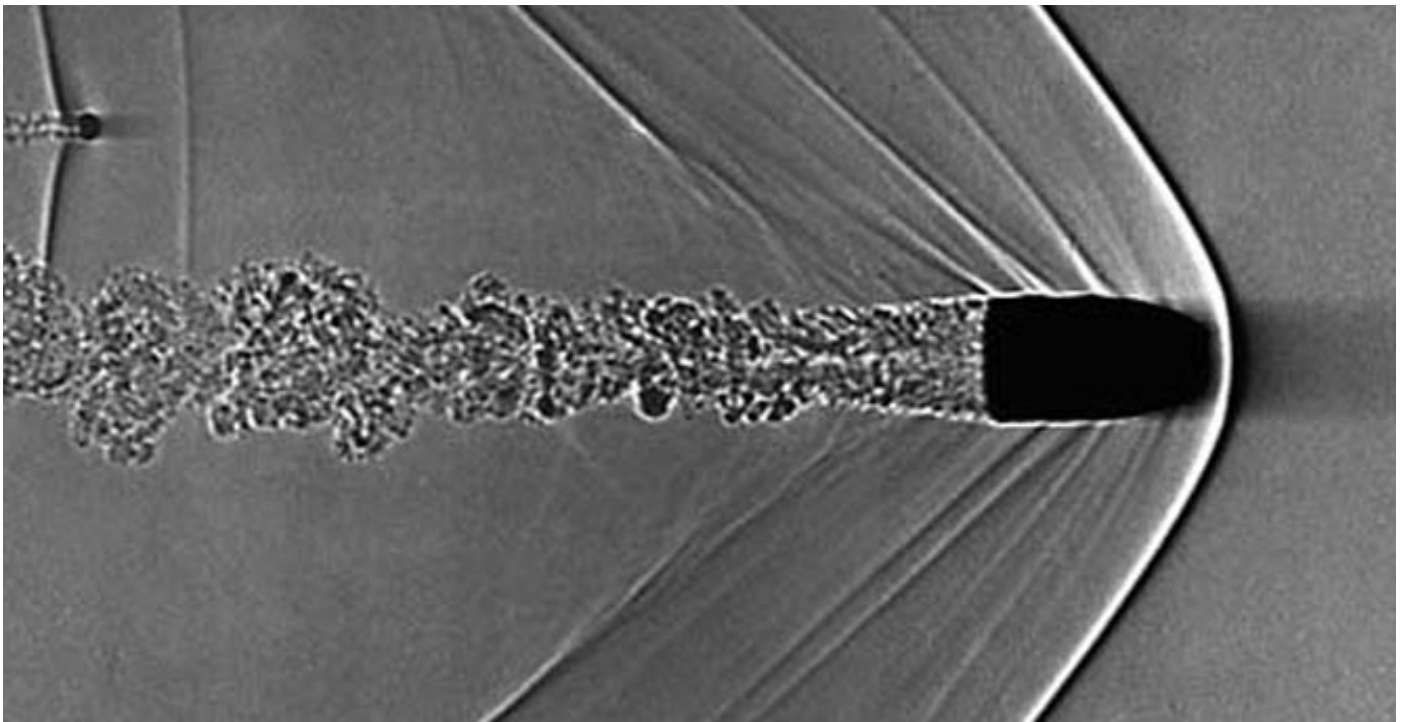




# DHB Armor Group Armor Safety Report

August 1, 2004



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## Introduction

As of this writing, there are continuing questions and concerns regarding the potential for an unexpected loss of ballistic performance of some soft body armor systems under normal wear conditions. The research project described in this report was undertaken by the DHB Armor Group as a result of a reported failure of another manufacturer's vest worn by a Pennsylvania police officer. It was reported that a bullet fired from a .40 S&W caliber handgun penetrated the vest. The vest was an NIJ certified level IIA, constructed of 100% Zylon® (PBO) fabric and manufactured by Second Chance Body Armor of Central Lake, Michigan.

In addition to the reported vest failure, Toyobo, Ltd., the Zylon® (PBO) fiber producer, had been reporting that it had observed a loss of fiber tensile when the fiber was exposed to laboratory conditions of high heat and high relative humidity for extended periods of time. Toyobo also advised that prolonged exposure of the fiber to visible light contributed to the loss of tensile strength. Although Toyobo's test determined a loss of tensile, Toyobo did not make a correlation to ballistic performance as it relates to body armor at that time.

The intent of this project was to investigate whether the reported tensile loss affected or impaired the ballistic performance of Point Blank and PACA armor systems. It was not the intent of this study to make or address any particular claims regarding the performance or lack thereof of any ballistic fiber, fabric or ballistic material, or to comment on any armor products other than the Point Blank and PACA samples tested. No inference should be drawn with regard to anything other than the specific matters discussed with regard to the DHB Armor Group products.

## Scope

An intensive testing protocol was established that would enable us to inspect and test Point Blank/PACA armors that had been in use in the field for periods of up to four years under varying environmental and storage conditions, and to compare their performance with newly produced armors of the same design. In addition, Point Blank armors that had not been worn but had been produced more than three years ago and stored in our non-environmentally controlled South Florida warehouse, where they were exposed to the normally high South Florida temperature and relative humidity, were compared with newly produced armors of the same design. In order to validate whether any performance decay was fiber-specific, armors that *did not* contain Zylon® (PBO) fiber were also tested with the same parameters.

The analysis of both Zylon® and non-Zylon® based armor is critical to the validity of the study. By including non-Zylon® based armor systems in our study, we were able to establish a "control". The control establishes a basis of comparison between non-Zylon® and Zylon® based armor systems. Without a control, there is no way of knowing whether any performance decay observed was a result of a specific fiber degradation or the result of normal wear-related performance decay that might occur with all fibers.

## Previous DuPont Study

It is universally accepted that soft body armor experiences performance decay over time as result of normal use and, in some cases, improper care. To our knowledge, the last comprehensive study on testing of used armors was a study of used Kevlar® armors conducted by DuPont and published in 1987.

The DuPont study tested over 300 used armors ranging in age from 3 to 10 years, and concluded that some armors wear out sooner than others and that "performance decay" seemed to be related to the amount and type of wear and the quality of care. DuPont reported that "roughly 25% of the

old, used vests we have tested showed significant ballistic performance decay.” Based on these findings, DuPont made recommendations for annual inspections of armor and recommended replacement when conditions dictated. The report is entitled “*Rational Replacement Of Used Concealable Body Armor – An Up-To-Date Discussion Of DuPont’s Recommendations*”. A copy of the DuPont report is attached, beginning on page 9.

### **Our Test Methodology**

Our testing was performed, and the test data recorded, by employees of the DHB Armor Group Technical Division who have many years of experience testing soft body armor systems.

V50 ballistic limit testing as set forth in Mil Std. 622F was used to gather data in this analysis. The NIJ 0101.04 9mm 124 grain FMJ projectile was selected as it has become the industry standard for V50 performance comparison testing.

As of this report date, **190 armor panels** have been tested to gather data using the Mil Std 622F V50 methodology. Testing to date provided **1,538 data points** for analysis. Of the armors tested, 10 of the model designs tested were multi-material hybrids containing Zylon® (PBO) fiber in their construction. The amount (by weight) of Zylon® (PBO) in these model designs ranged from 26% to 73%. Also included in the study were two model designs containing *no* Zylon® (PBO) in their construction. They also are multi-material hybrids.

Note: None of the tested armors was constructed of 100% Zylon® (PBO) fabric, as it was not our intent to evaluate vests such as the Second Chance vest. The specific intent of this study was to discover whether there were any safety issues with Point Blank and PACA armor systems.

### **Samples tested**

- New armor samples just manufactured. (To establish a baseline.)
- New armor samples stored in non-controlled

heat/humidity environment for up to 4 years in a South Florida warehouse. (To determine if there was shelf life decay.)

- Used armors from one to 4.5 years old, from various areas of the United States, and with varying conditions of wear. (To determine if there was any decay that resulted from wear and use and/or improper care.)

### **Test Data Analysis**

As a control, baselines were established for each model system selected. The baseline was established by using the NIJ certification V50 data as well as the new, just manufactured, armor V50 data. When comparing the baseline data to the used vest samples, changes in performance could be measured.

A comparative analysis was conducted on the collected data comparing the sample groups as follows:

- **Category 1** – Zylon® hybrids - Baseline against *used* samples (see Fig. 1 on pg. 5).
- **Category 2** – *Non-* Zylon® hybrids - Baseline against *used* samples (see Fig. 2 on pg. 5).
- **Category 3** – Zylon® hybrids - Baseline against *unused* 3-year-old shelf stored samples (see Fig. 3 on pg. 6).
- **Category 4** – *Used* Zylon® hybrids against *Used* Non-Zylon® hybrid samples (see Fig. 4 on pg. 6).

**Category 1** - In comparing baseline data with Zylon® hybrid *used vests* test data, an average performance decay of 2.2% was observed. This percentage translates to an average loss of 37 fps (feet per second) below the baseline V50. The standard deviation (sigma) for the **Category 1** samples is 52 fps. Therefore, the observed change in performance did not amount to 1 sigma. It is further important to note that only four of the total 114 *individual used* vest panels tested fell below 3-sigma of the baseline. (*3-sigma +/- is the maximum standard deviation allowed for retest of new armors- NIJ 0101.04.*) All of these sub-baseline vest panels were in very poor condition, were badly stained and had a significant

number of “set wrinkles”. Although these panels fell below the baseline, none had any “low complete” penetrations below the NIJ 0101.04 maximum velocity for that threat level vest.

**Category 2** – In comparing baseline data with non-Zylon® (PBO) *used vests* test data, an average performance decay of 1.5% was observed. This percentage translates to an average loss of 25 fps when compared to the baseline V50. The standard deviation (sigma) for the Category 2 samples is 46 fps. Therefore, the observed change in performance did not amount to 1 sigma; and, none of the individual used vests tested fell below the established 3-sigma baseline. As in the Category 1 testing, there were no “low complete” penetrations below the NIJ 0101.04 maximum velocity for that threat level vest.

**Category 3** – In comparing baseline data with Zylon® hybrid *unused vest* samples that were more than 3 years old and shelf stored in a non-controlled environment, the average performance decay was 2.3%. This percentage translates to a loss of 37 fps below the average baseline V50.

**Category 4** – In comparing the average 2.2% performance decay of the *used* Zylon® hybrids tested against the 1.5% average performance decay of the *used* Non-Zylon® hybrids tested, the difference was 0.7%.\*

In comparing the average 2.2% performance decay of the *used* Zylon® hybrids tested against the 2.3% average performance decay of the *unused shelf stored* Zylon® hybrids tested, the difference is 0.1% (see Fig. 5 on pg. 7).\*

*\* A difference of less than 1% is statistically not significant.*

## **Conclusions**

- None of the *used vest* groups tested showed any significant performance decay.
- Only four of the total 114 *individual used vest* panels tested fell below the 3-sigma baseline, and these samples were in very poor condition.

- There was no significant difference in performance decay between Zylon® (PBO) hybrids and non-Zylon® (PBO) hybrids manufactured by Point Blank and PACA.
- None of the *individual vests* tested had any “*low complete*” penetrations below the **highest** NIJ 0101.04 test velocity in their respective levels.
- We discovered no safety issues with Zylon® (PBO) hybrids manufactured by Point Blank and PACA as a result of this testing.

The findings of this project are consistent with the study conducted by DuPont, which was published in 1987. We, like DuPont, also concluded that performance decay over time is likely related to the amount of use, type of use and quality of care. Armor not properly cared for will likely decay at a faster rate. Therefore, it is extremely important for users to closely follow care and storage instructions provided by the manufacturer.

*Disclaimer: This report has been prepared solely for informational and discussion purposes, and does not constitute any representation or warranty as to the performance, attributes or uses of particular soft body armor systems, whether manufactured or sold by members of the DHB Armor Group or by other manufacturers or distributors. Purchasers and users of soft body armor systems of the type described herein (or any other systems intended to provide bullet-resistant protection to the wearer) are urged to evaluate their needs on an individual and ongoing basis, and may only rely upon the specific warranties provided by the manufacturer and/or seller of the subject armor. Reasonable efforts have been made to report the results of these tests in a fair and accurate manner, but no representation or warranty is made regarding the testing procedures and methodology, or whether the same results would be obtained in other studies conducted under these or other testing parameters.*

## **To Our Customers**

The DHB Armor Group is dedicated to officer safety. We have been saving lives since 1973. Unfortunately, the controversy surrounding the 100% Zylon® vest

has created a general and broader loss of confidence in body armor manufacturers and fiber suppliers. This loss of confidence is understandable. With little valid information available and, in some cases misinformation, it is easy to see why so much confusion exists. We want to restore your confidence in Point Blank/PACA products and want to assure our customers that we continue to be totally committed to officer safety and continue to engineer and provide the best armor for the law enforcement community. We sincerely hope this report has provided useful information for you to make sound armor safety decisions.

**The DHB Armor Group Technical Division will continue to test new and used armors as part of our ongoing quality assurance programs.**

### **Armor Replacement**

The DuPont “*rational replacement of used concealable body armor*” recommendations are supported by Point Blank and PACA. They have become part of our consumer information literature. A copy of the entire DuPont document is attached, beginning on page 9. The following are the DHB Armor Group recommendations, which represent the essence of the DuPont recommendations.

Follow up questions may be directed via email to Mr. Tom Dragone, DHB Armor Group Technical Division, at [tdragone@pointblankarmor.com](mailto:tdragone@pointblankarmor.com).

### **DHB Armor Group Body Armor Replacement Recommendations**

In order to assist our customers in making decisions on when to replace body armor, the DHB Armor Group (Point Blank Body Armor/PACA) has put together some points you may want to consider in the evaluation process.

Most manufacturers warrant the body armor they sell for a period of five years. In the case of Point Blank Body Armor/PACA, body armor is warranted for five years against manufacturing defects. This is a reasonable period of time for a manufacturer to warrant a product that will be out of its control and in

use in the field. The end of the warranty period does not mean the armor will not provide some protection. It merely means, “The warranty is over”.

Soft body armor materials like clothing are subject to wear. Although there is clear evidence of some ballistic performance decay as a result of wear and improper care, armor that is properly cared for should continue to provide protection.

Here are some things you may want to consider when making a decision to replace your body armor:

- **Is the armor "excessively worn"?** *Does it need to be replaced because it has “set wrinkles” or is in bad condition and is visually worn out?*
- **Hygiene.** *Even with proper care, is there mildew and/or staining of the ballistic element?*
- **Does the armor still fit?** *Has your body size or shape changed since your armor was issued/purchased?*
- **Have the threats in the street changed?** *Are there different types of weapons being encountered or confiscated on the streets?*
- **Has your service weapon or ammunition changed?** *The armor you wear should be capable of stopping the ammunition you carry.*
- **Have the body armor standards changed to meet the new threats?** *Does the agency require its armor to be certified to the latest body armor standard?*
- **New technology in ballistic fibers and engineering.** *New fibers and design technology have made armor lighter and more comfortable to wear. Further enhancements may become available.*

*Remember, “Armor that is not worn cannot save lives”.*

*Because of these considerations, Point Blank/PACA supports the earlier DuPont recommendation that you have a regular annual inspection program for body armor and consider replacement in three to five years. When to replace the armor is directly dependent on its condition, not on the length of the manufacturer’s warranty.*

Figure 1  
Category 1: Z-Hybrid Baseline/Used

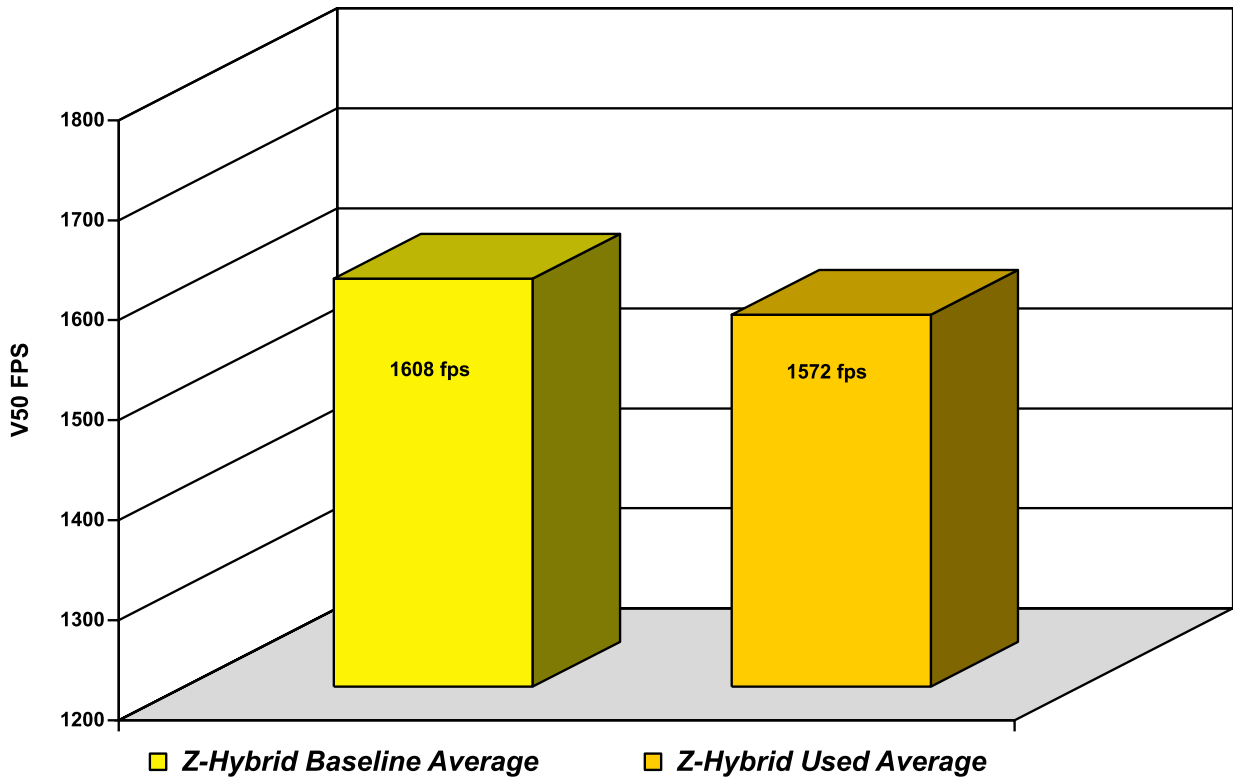


Figure 2  
Category 2: Non Z-Hybrid Baseline/Used

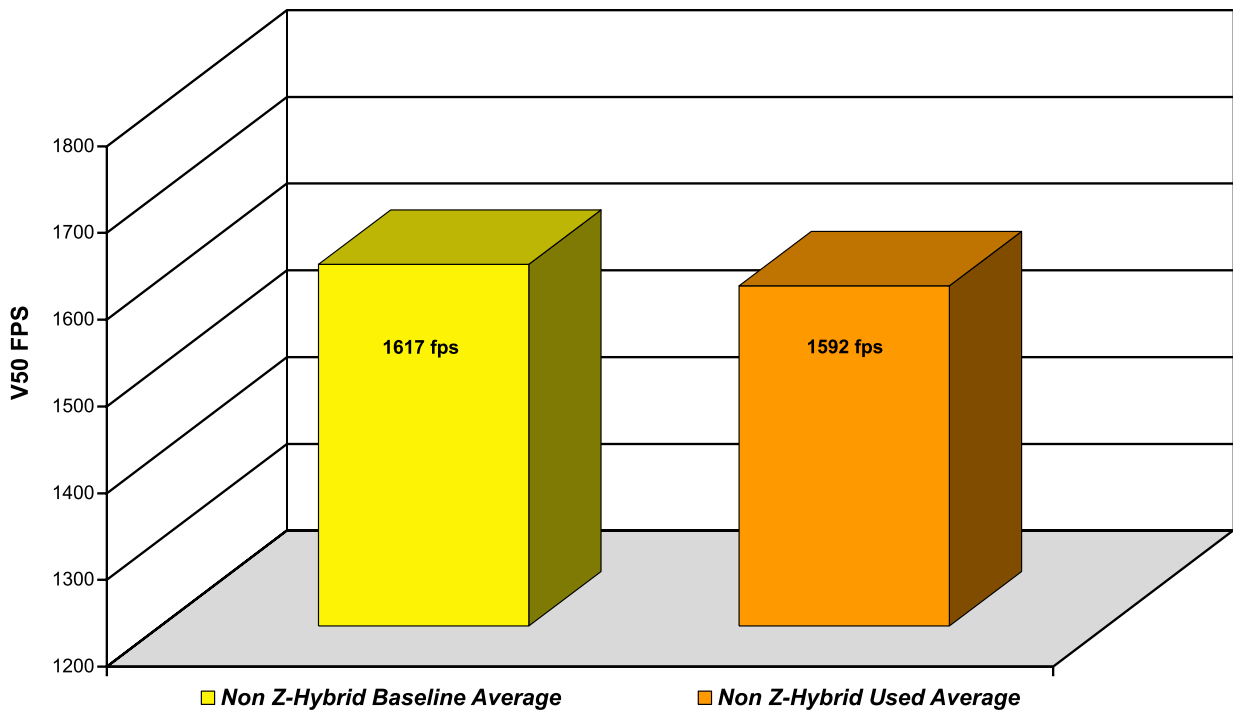


Figure 3  
Category 3: Baseline/Shelf Stored

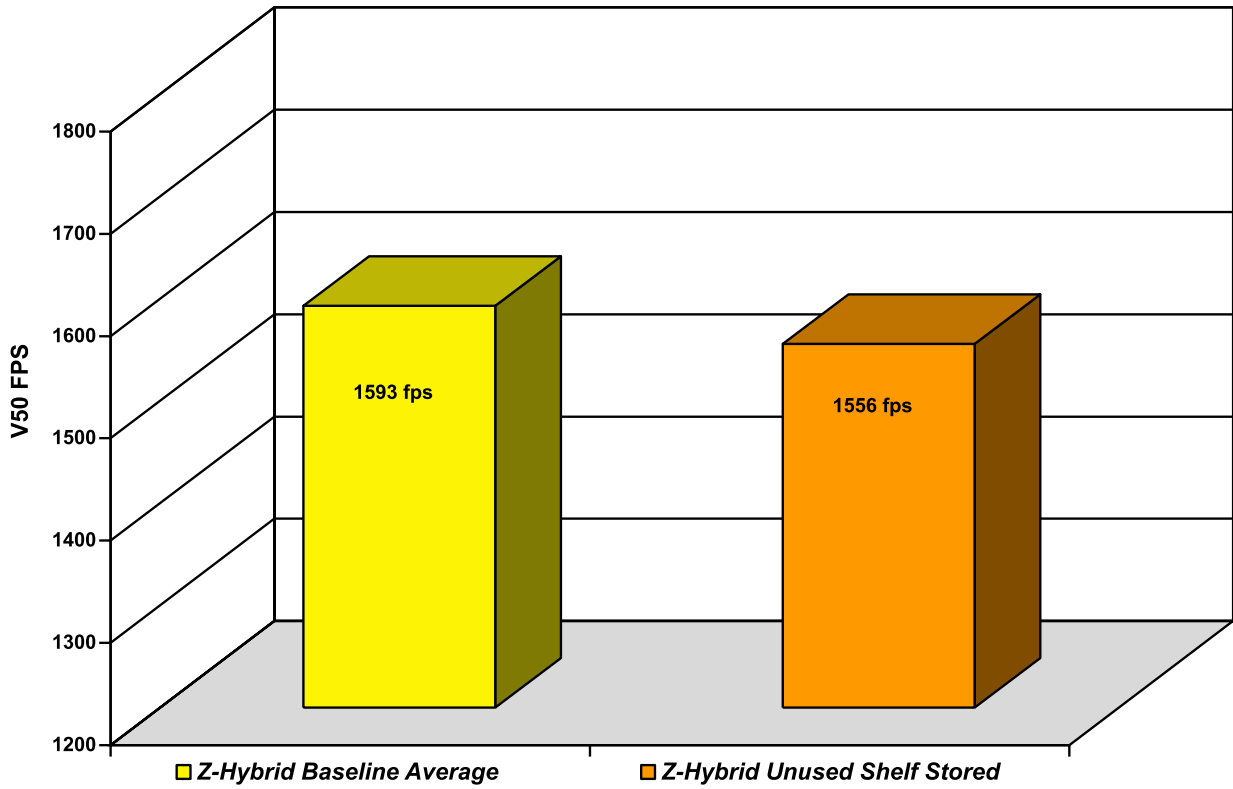


Figure 4  
Category 4: Used Vests Z-Hybrid/Non Z-Hybrid

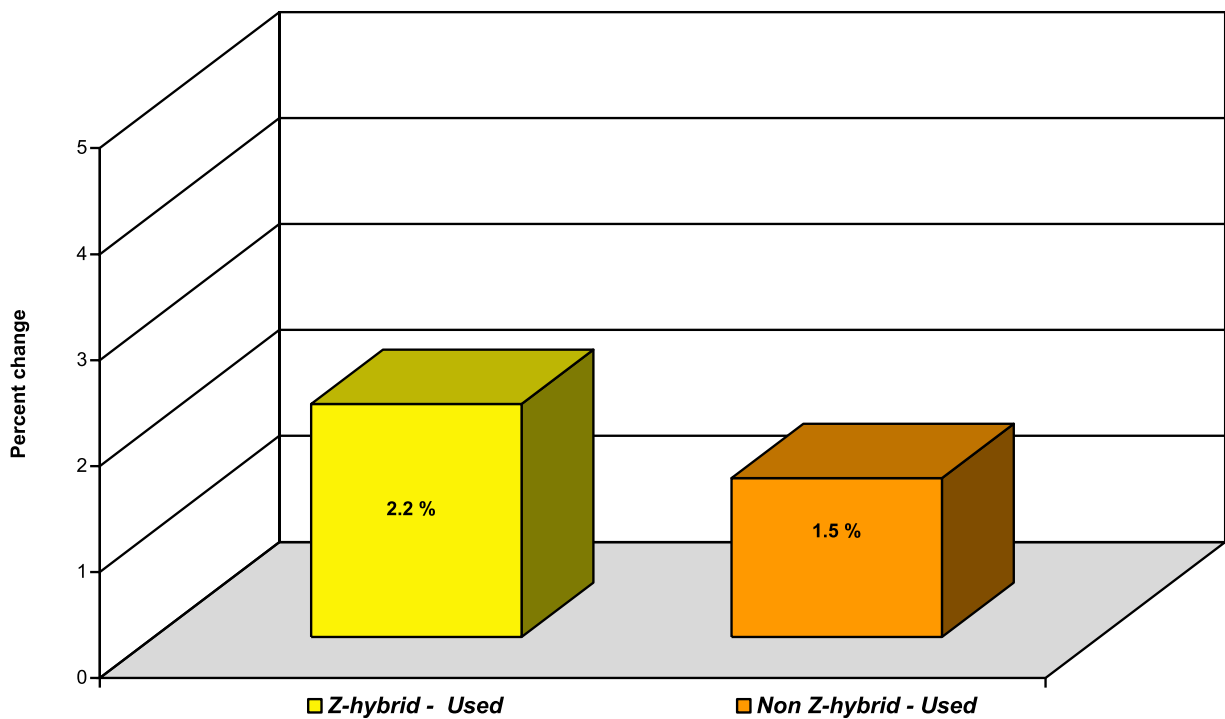
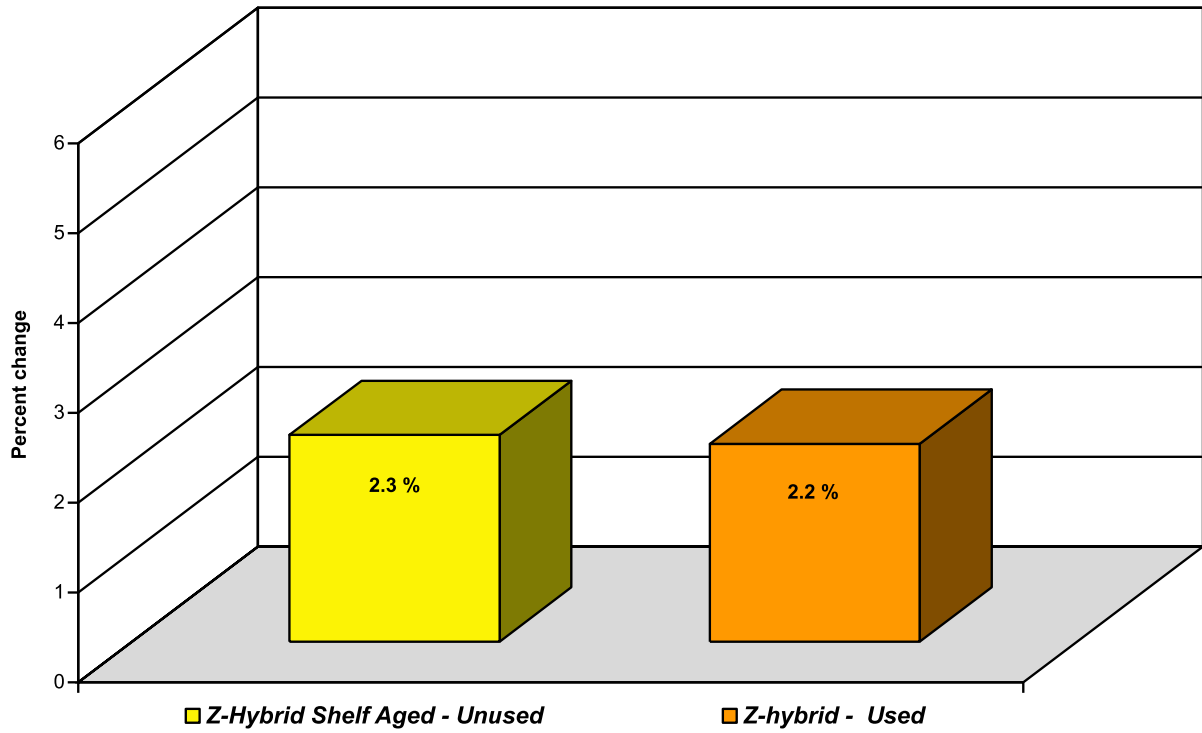
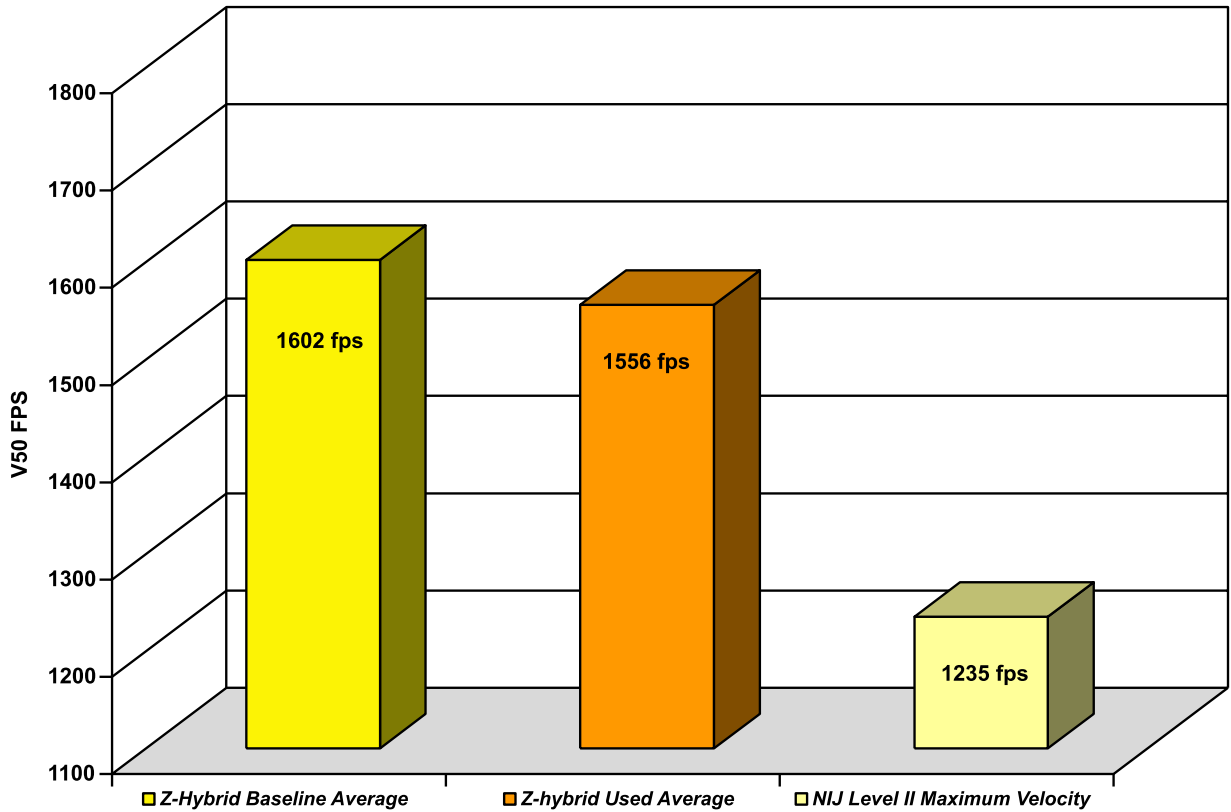


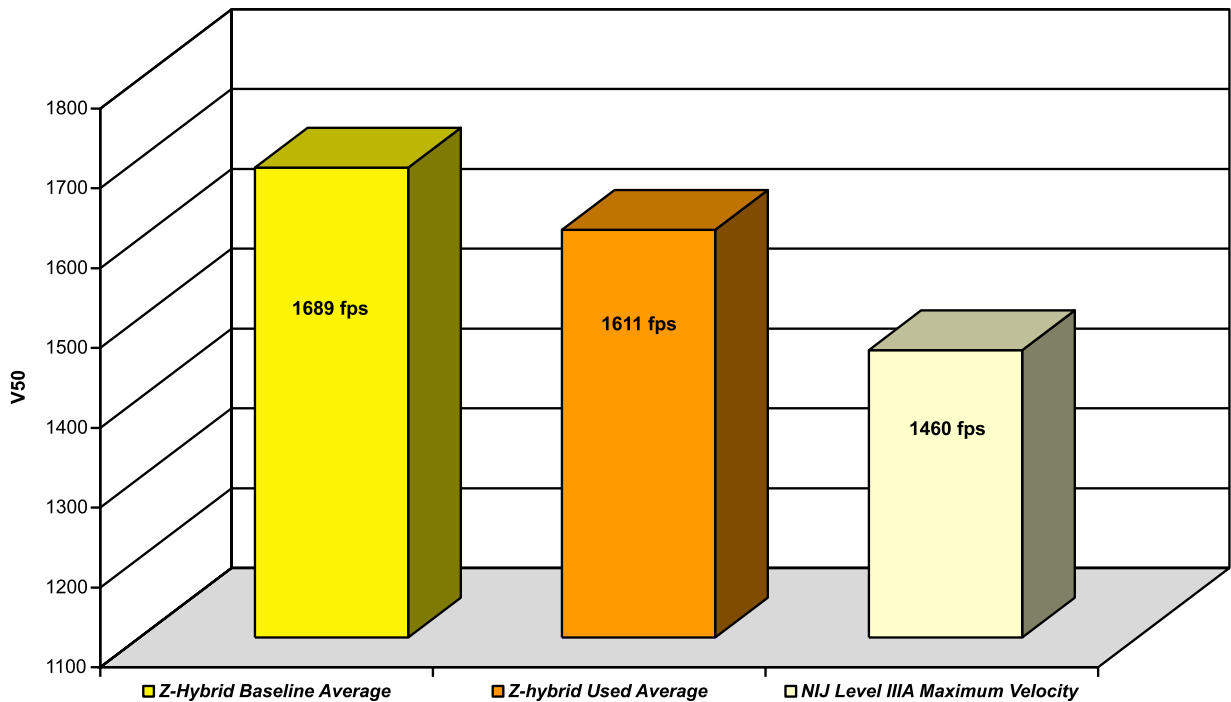
Figure 5  
Unused Shelf Stored/Used



Supplemental Figure A  
Z-Hybrid Level II Baseline/Used



Supplemental Figure B  
Z-Hybrid Level IIIA Baseline/Used



## Rational Replacement Of Used Concealable Body Armor An Up-to-date Discussion Of DuPont's Recommendations

By Thomas E. (Ed) Bachner, Jr.

### **Introduction:**

*Replacement of used personal body armor is both an important and complex issue. DuPont has tested old armor for law enforcement and developed rational replacement recommendations based on this research. This paper provides up-to-date clarification and perspective. Particular emphasis is placed on ballistic performance decay and the multiple reasons for periodic replacement.*

### **Background:**

The Need: Concealable body armor of Kevlar® Aramid has been protecting police officers since 1972. During the early 80's many police forces and individuals started to become concerned over the age and appearance of their bullet resistant vests. As the manufacturers of Kevlar® and the principal supplier of body armor technology, DuPont began to get frequent questions about how long personal body armor could reasonably be expected to last. Law enforcement clearly needed answers with which they could make prudent replacement decisions.

The Data: Due to persistent requests from several major police departments – and because no one else had the funding, facilities, and expertise to do it – DuPont began testing old, used ballistic vests in Feb., 1983. By mid – 1985, enough studies had been completed that we had become concerned. Our concern, simply stated, was that, as remarkably durable as Kevlar® is, some body armor was wearing out. DuPont is a company that stresses safety and good corporate citizenship. Possession of this knowledge without communicating it to those whose lives may depend on the performance of their ballistic garments would have been grossly irresponsible.

The Complexity Of The Issue: By mid-1985, it had also become apparent that this was a very complex issue. In addition to the concern over ballistic performance decay with use and abuse, it was evident that much of the armor out there was obsolete vs. contemporary protection needs, standards, technology and designs. Also, a large majority of the old armor we had evaluated needed replacing because it was unwearable due to poor fit, set wrinkles, or appearance problems such as build up of body oils, fungus, mildew, etc. Finally, much of the armor simply looked “worn out” – and failed to inspire the confidence to wear.

The Recommendations: During 1985, DuPont developed a common sense, data based thought process now known as the “Rational Replacement” policy recommendation. As we informally shared this with interested vest owners, Police departments, and organizations, the responses were overwhelmingly favorable. These thoughts were formalized when the IACP asked us to share our thinking at their annual Research Committee hearing. Since then, further research has continued to support those 10/85 recommendations. Following is an up-to-date discussion of the research data and the logic.

DuPont's Old, Used, Vest Test Data: DuPont has conducted more than 300 ballistic tests on old body armor from 30 separate police departments representing 10 different manufacturers. These tests and the growing array of visual and other technical evaluations continue to teach us what a truly complex subject this is. Our data shows that Kevlar® is remarkably durable in soft body armor. However, the fact that body armor will eventually deteriorate with use and/or abuse has also been clearly established. Although further research is needed, several points are clear:

\*\* Roughly 25% of the old, used vests we have tested showed significant ballistic performance decay. We define these “failures” as vests that either did not pass NIJ type, go-no-go tests, or were 8% or more low (statistically and practically significant) in V50 “Ballistic Limit” performance (V50 is the

velocity at which a given bullet will be stopped by the armor 50% of the time and penetrate the armor 50% of the time). Although such negative shifts in performance do not mean a vest is totally worn out, they show the vest has begun to deteriorate – we believe to the extent it should be replaced.

Additionally, there exists a negative “directionality” in most of our old, used vest test results. For instance, ballistic protection of all used vests tested by us prior to our October 1985 recommendations have averaged 7% below (unused) controls. These vests ranged from 3 to 10 years in age. The individual vest ballistic performance ranged from + 4% to – 26%. Use of good controls with these tests rules out the possibility of poor initial performance (i.e. bad quality control) – confirming real performance decay with use.

Perhaps the best way to view this data is in terms of an overall “picture” of test results vs. control results. Figure 1 shows such a picture by plotting V50 (primarily 9mm and .357 Magnum) by “Merit Factor”, or percentile variation expressed mathematically. For example, a “Merit Factor” of .90 would mean the vest had tested 10% below the unused control. Please note all control data points fall well within the normal statistical variation (plus or minus 3-sigma or 7.5%) around our historical database. The old, used vest test results, however, show a generally lower, much wider scatter. Indeed, the used vest population performed at only 93% of control, on the average.

\*\* Ballistic performance decay is not a function of age alone. Deterioration does not occur without plenty of use and/or abuse. Although decay has been measured after as little as three years, so far this appears to be isolated to certain unique combinations of lightweight, minimal care, and very hard use. Most of the performance we have measured has been in vests worn for over five years.

\*\* So far, all instances of ballistic performance decay have been accompanied by “visual signals”. For example, some of the vests that tested badly clearly appeared to have been heavily worn. They

showed typical garment deterioration, such as fabric fraying / abrasion, weave raveling, fiber flex fatigue or bad staining. Other poor performers showed the tell tale signs of abuse such as a light, “washed out” appearance indicating exposure to bleach – or a brownish “suntanned” color, indicating exposure to sunlight. However, we have seen similar appearances without finding significant ballistic decay – but those vests had generally been replaced anyway, as unwearable.

\*\* Ballistic performance deterioration seems to vary individually and be heavily related to the amount of use, kind of use, and quality of care. It appears that just like uniforms, some officers simply wear their vests much harder than others. Since we want police officers to wear their vests all the time when on duty, we have to allow for a wide variety of wear/care patterns in our replacement planning. This included the potential for earlier replacements on an individual basis when inspection indicates.

\*\* Evaluating old armor is complicated. Unfortunately, there is not yet any good way to determine ballistic performance without sophisticated, destructive laboratory tests. Even with such testing expertise and equipment, high technology textile knowledge and experience in old vest analysis are also needed, or well-intentioned activities can generate misleading information. For example, DuPont has assisted more than one department in avoiding potentially costly premature replacement mistakes they would have made based upon testing they conducted.

Note: Ballistic armor testing is not only a difficult, sophisticated task – it can also be dangerous! Proper evaluation of any old or new vest requires sound ballistic testing knowledge. Body armor should never – repeat never – be shot without adequate knowledge in proper, safe test procedures, or personal injury can result.

\*\* Many of the vests we examined had been replaced for reasons other than ballistic decay. What we learned about these is best summarized in a

contemporary statement of our recommendations. (below)

### **Comprehensive Research Report Now Available**

Louis H. Miner, DuPont Industrial Fibers Research Associate, is one of the world's most knowledgeable technical experts in the field of soft body armor ballistics. He has studied this specialized field of science since 1974. Further, his overall textile technology background specializing in high strength fibers like Kevlar® makes him uniquely qualified to guide our technical evaluations and development efforts. Miner had the foresight to begin studying old, used in 1983. For those who desire more detail, he has now published a comprehensive technical paper: "Ballistic Testing Of Used Soft Body Armor Of Kevlar® Aramid".

### **Research Continues – Confidential Armor Testing Available**

DuPont's old armor evaluations continue to raise new questions and teach new lessons – important lessons such as the value fragment simulator, fiber tensile strength, wet vest testing, etc. Hence, we end up with an opportunity for a valid partnership: By continuing our old vest research, we gain knowledge, expertise and (hopefully) new technology – and the police department gains valid information about the condition of their vests. To participate, just contact us.

### **DuPont's Current Recommendations**

Today, after more than four years of research and analysis, plus extensive consultation with federal, state and local law enforcement agencies, government representatives, manufacturers, and other experts, DuPont continues to recommend a three part, common sense, "Rational Replacement" program. This recommendation is specifically designed for frequently worn, concealable body armor. Nevertheless, many of the same thoughts might be applied to infrequently worn concealable armor or tactical/special purpose armor. Note: Since

the "shelf life" of unused soft body armor is thought to be practically unlimited, ballistic decay without use is unlikely. Lets take a quick look at the three part recommendation:

1. Annual departmental inspections to spot obvious signs of poor fit or unusual wear/abuse – and to encourage use! Any vest that no longer fits or is obviously in poor condition should be replaced – if for no other reason that it is unlikely to be worn. Such an inspection, we believe, can also be used to encourage wear and proper care for this potentially life saving device. Look also for the vest that shows abuse or zero wear – and take steps to correct either! F.B.I. data indicates 40-50% of the officer's shot to death each year could have been saved by wearing lightweight body armor. Use this inspection to promote its use and make sure it is well cared for!

Note: In response to requests from police departments across the nation, inspection recommendations based upon our old vest evaluations are being developed. Although not ready for formal publication, we are happy to share thoughts with those who request them.

2. Annual ballistic testing of representative vests starting at 3 years of age: This is an "extra precaution" to insure that your department's use or care patterns aren't resulting in unusual deterioration. We have recorded "line of duty" situations where ballistic decay has occurred in as little as three years of obviously very heavy wear. These are not thought to be typical, but we do caution departments to spot check for it. Since ballistic tests are destructive, this is not possible for individual owners. We suggest individuals simply make sure they are following the manufacturers' care and cleaning suggestions – then replace periodically as discussed below.
3. Replace personal body armor after five years of use: The five-year replacement cycle is a practical, common sense recommendation. It is designed to take into account the many relevant factors – no one issue or concern. It is our best thinking, based

on all we have learned through extensive old vest evaluations and dialog with experts. It assumes that the vest in question gets used frequently and recognizes law enforcement's need for definitive planning cycles. It is DuPont's best judgment, taking the following important factors into consideration.

- **Changing protection needs and standards:** Officer killings with medium and high-energy handguns (.357 Mag., 9mm, etc.) rose from 13% of the firearms slayings in 1974 to 35% in 1984 (F.B.I. stats.). Indeed, police officers have recently been killed and wounded by handguns just too powerful for the old, lightweight or low coverage vests they had on at the time. Changes in threats on the street and law officers' protection needs are expected to continue.

Additionally, in March 1985, the National Institute Of Justice voluntary ballistic standard, against which much body armor is designed, was changed so drastically that little of the armor produced prior to the change would pass the new, tougher, repetitive shot/angle hit specification. Since meeting this is much tougher, continuing to meet it with armor in use is a key question for the future. Yet another, still tougher standard has just issued.

- **Changing Officer Weapons and Ammunition:** As the threat on the street has increased, recognition of the better weapons criminals have is causing law enforcement weapons and ammunition changes. Since 15-24% of the officers killed each year are slain with their own weapon, departments should always review their personal body armor when weapons and/of ammunition change.
- **Changing Personal Dimensions:** We believe that keeping officers in comfortable fitting vests as they gain, lose, or re-distribute weight is of major importance. A vest that does not fit comfortably isn't likely to be worn, and ought to be replaced with one that will. Also, sometimes body armor does not get worn because the uniform shirt has "shrunk", no longer fitting over both the body and vest. In this case, buying a new uniform shirt could pay big

dividends, if it gets the officer to start wearing the vest again. Be sure to check both vest and uniform shirt fit during the inspection.

- **Hygiene:** Vests are underwear: Many of the old, used vests we evaluate in our lab are so "grungy" that they aren't very likely to be worn – and need to be replaced with one that will be. Hygiene concerns also suggest that any well worn vest should not be re-issued to a second officer – would you wear your partner's underwear?
- **Set Wrinkle Development:** A common phenomenon seen in old vest evaluation is "set wrinkles" – heavy, "roll" wrinkles set into the multiple layers of fabric. They develop in some old, well-worn vests and are difficult to get out – and very uncomfortable. Again, an uncomfortable vest is not likely to be worn, and should be replaced.
- **Improved Technology and Designs:** Incremental improvement in fiber and fabric manufacturers, coupled with many design improvements from the vest manufacturers, have resulted in major improvements in product offerings. Today, one can buy a much better fitting, more ballistically efficient product – one that is more likely to be worn. For planning purposes, we should expect vest improvements to escalate in the future, just like other technologies.
- **Protection Decay With Use and/or Abuse:** As previously stated, Kevlar® has proven to be remarkably durable in concealable body armor. However, everything wears out eventually. DuPont has now conducted used vest evaluations for police departments all over the U.S. We have also recently sponsored foreign military vest aging studies in independent labs, with results consistent with our own. At the time of this writing, roughly 25% of the 300 old, used vests tested have shown significantly less than "like new" ballistic performance. Ballistic performance decay with use and/or abuse occurs just as one might expect. It just makes good sense to replace old, used armor before there is much likelihood that an officers' protection is beginning to deteriorate.

## **Summation**

When soft body armor of Kevlar® should be replaced is a complex question. It requires consideration of many important interrelated factors. To assist individuals and police departments in their planning, and to develop further useful research data, DuPont continues to study old, used vests.

Based on more than four years research, DuPont recommends a three part, common sense approach for regularly worn, concealable body armor. This “Rational Replacement” recommendation includes annual fit and wear inspections, ballistic testing on representative vests starting with three years use (individual owners disregard as impractical), and replacement every five years. The five year change cycle is designed to take into account relevant factors such as changing protection needs and standards, changing weapons, ammunition and personal dimensions; hygiene factors, and set wrinkle development over time. Additionally, technology and design improvements with time and ballistic performance decay will occur with use and/or abuse.

## **Additional information**

We hope the above is helpful in providing the best information, clarification, and perspective available. To obtain additional ballistic armor information and DuPont’s Kevlar® Personal Body Armor Facts Book “Dress for Survival”, contact: Thomas E. (Ed) Bachner, Jr., Ballistic Account Manager, Fibers Marketing Center, Wilmington, DE 19898. (302) 999-3007. Kevlar® is DuPont’s registered trademark for Aramid fiber.

## **About the Author**

As Ballistic Account Manager, Ed Bachner represents DuPont on matters related to the use of Kevlar® Aramid in concealable body armor. He is responsible for DuPont’s Ballistic Testing Laboratory, communication and training support to law enforcement, and marketing support for the protective vest manufacturers. He serves as DuPont’s liaison with organizations such as the International Association of Chiefs of Police, Personal Protection Armor Association, F.O.P. Ladies Auxiliary, Concerns of Police Survivors, etc. Ed has a chemistry degree from Austin College, Sherman Texas, served as an officer in the United States Marine Corps, and had twenty years of broad textile experience. He and Lou Miner are generally acknowledged as the leading experts in the field of old armor evaluation.



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