



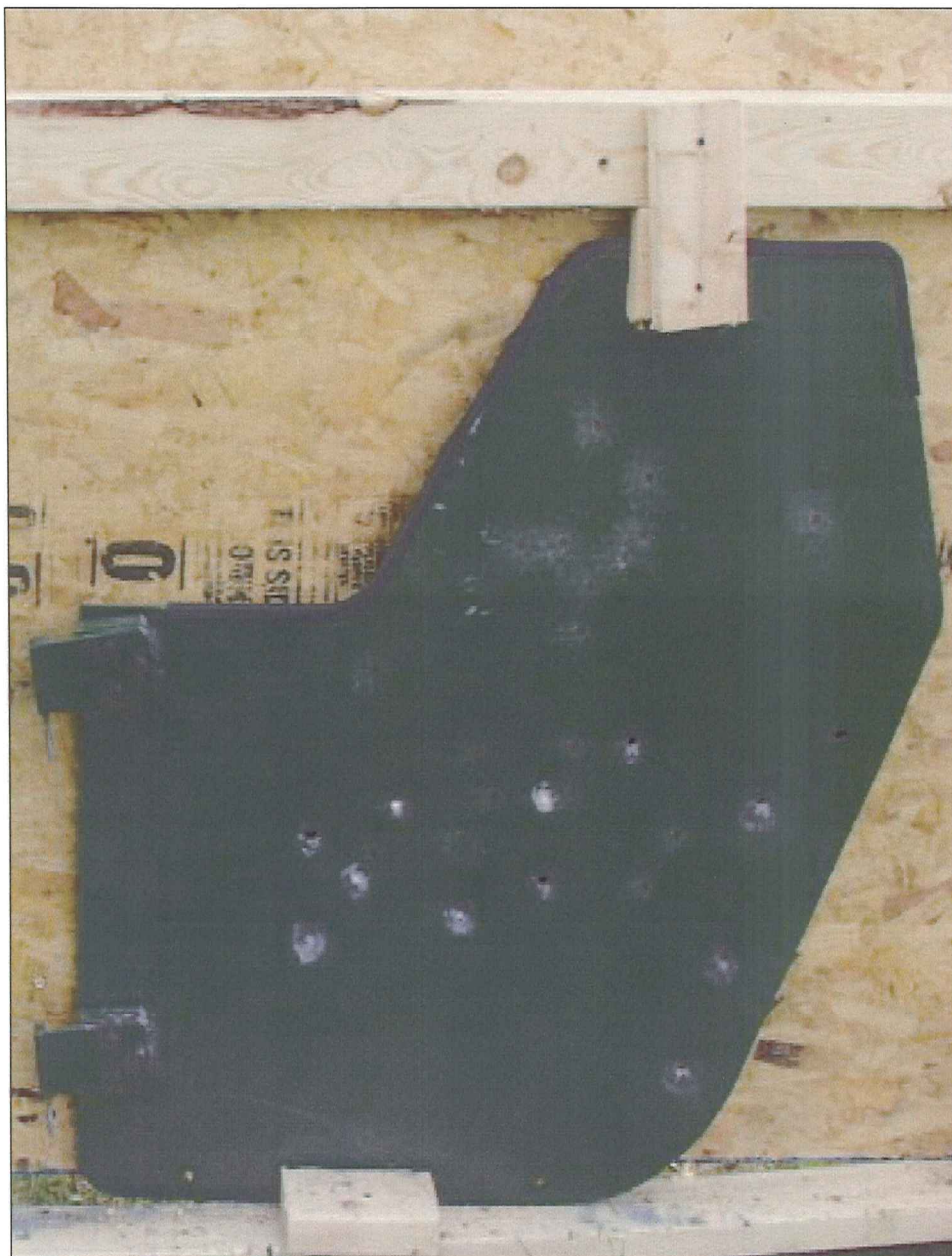
Snapback Rebound Effects Study Phase I, II and III

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Phase I

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Demonstrations at Quantico show a large number of bullet penetrations in uncoated 3/8" Rolled Homogeneous Armor (RHA) Humvee Doors.



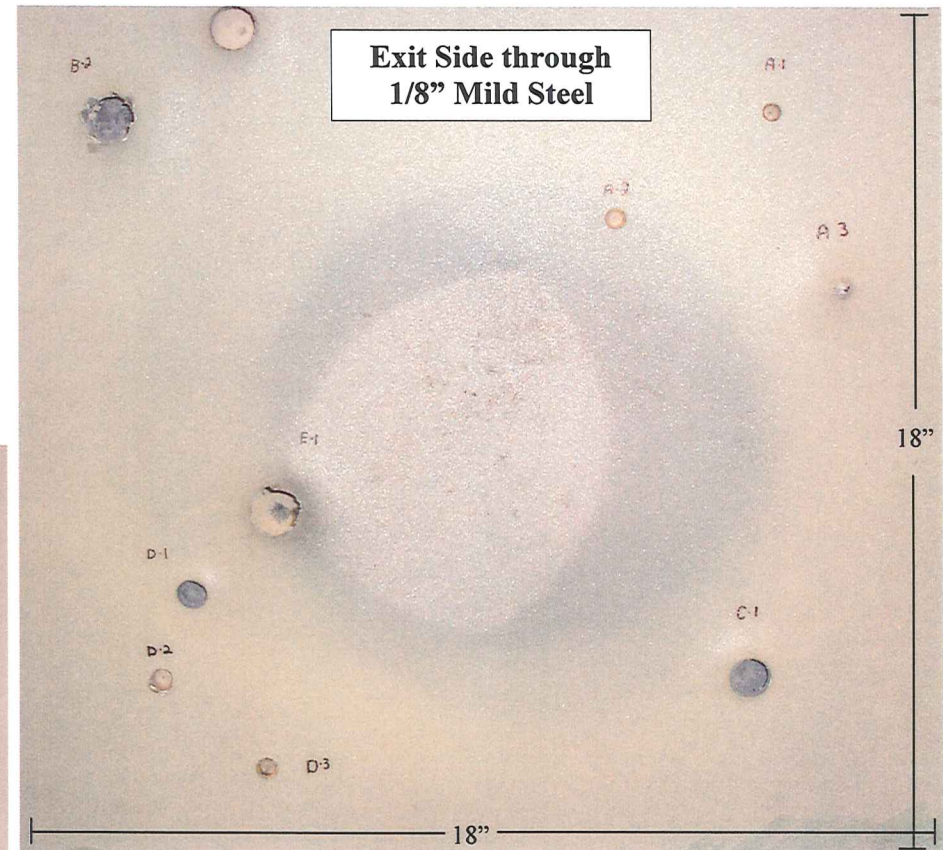
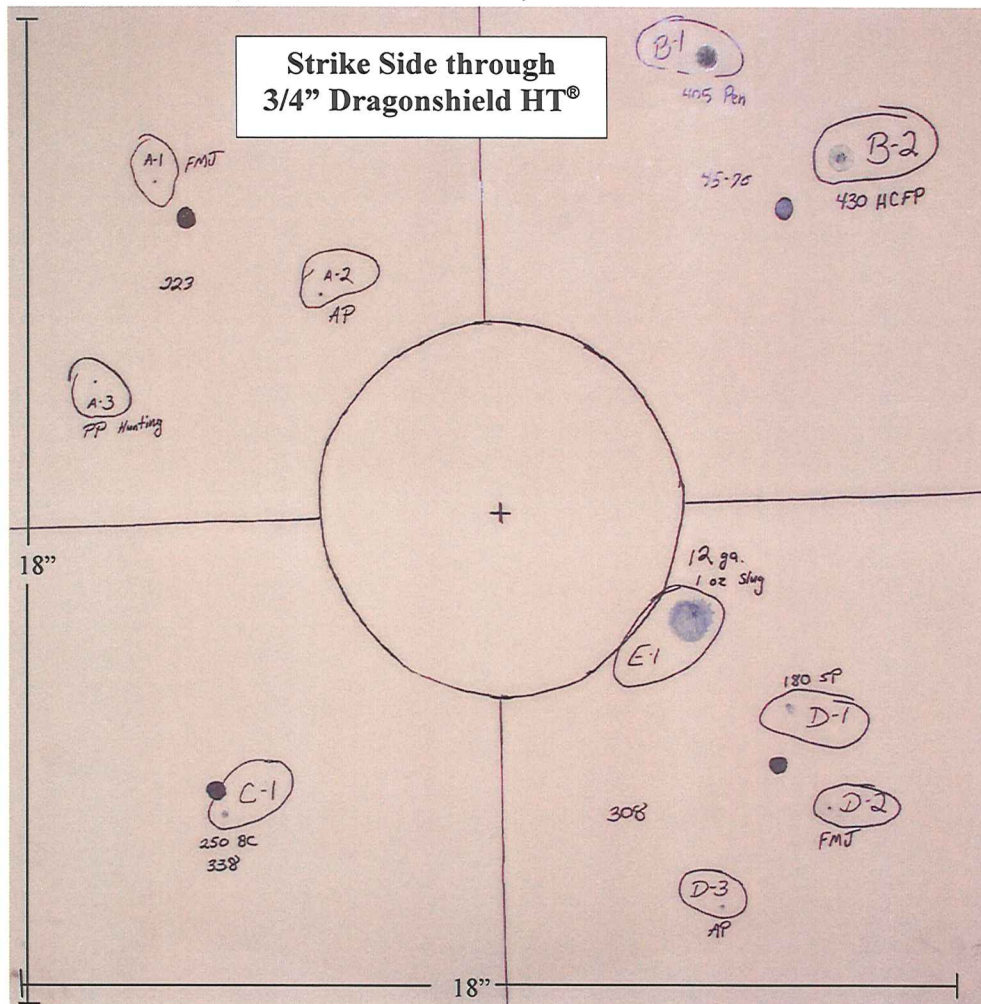
During the Quantico demonstration, numerous rounds of 7.62/54 Rmm were fired into the .202 HHS coated with Dragonshield HT[®] ERC. It was observed that the point of entry, through the coating, was nearly undetectable. Dragonshield HT[®] ERC had an instant "rebound" effect, which virtually closed the penetration hole. SPI has named this "Snapback Rebound Effect," and has a patent pending on this phenomenon.

Commencing in September 2004, SPI explored the "Snapback Rebound Effect" of Dragonsshield HT® ERC, a phenomenon for which SPI now has a patent pending.

For testing purposes, 1/8" mild steel was chosen to best represent the shell of a transport tanker. The variety of firearms and ammunition types was selected to assure penetration through the Dragonsshield HT® ERC and the 1/8" steel, in order to measure the diameter of entry and exit holes.

The 18" x 18" x 1/8" panels were sprayed with 3/4" or 1/2" (as labeled) of Dragonsshield HT® ERC.

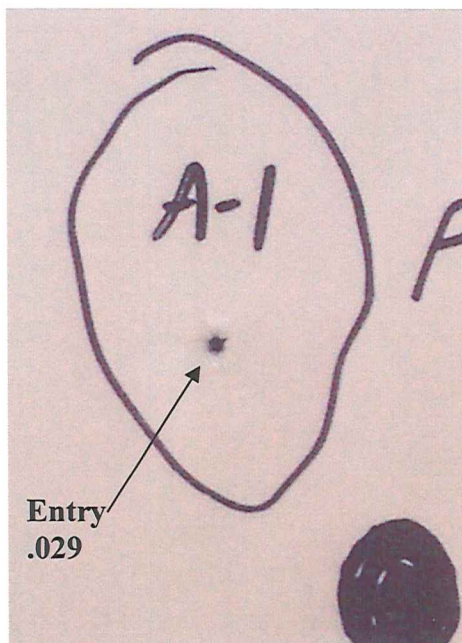
▼ Bullet Entries (18" x 18" x 1/8" Panel)



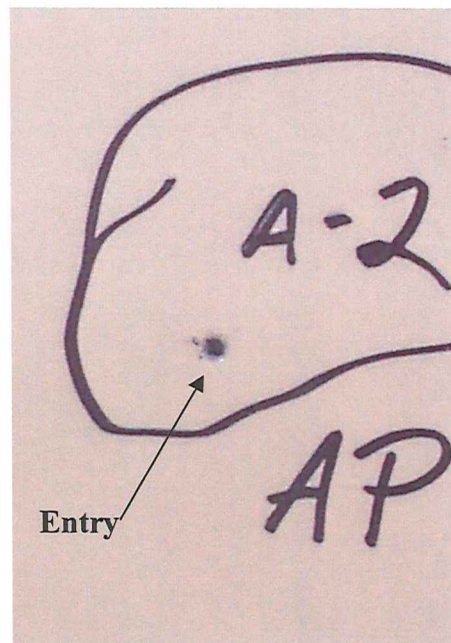
▲ Bullet Exits (Back side of same panel)

The following three (3) pages document bullet entry holes through the Dragonsshield HT® ERC, and exit holes in 1/8" steel panels. These photos demonstrate significant differences in entry and exit hole diameters. Also denoted under the photos are the type of weapon and bullet used for each hole.

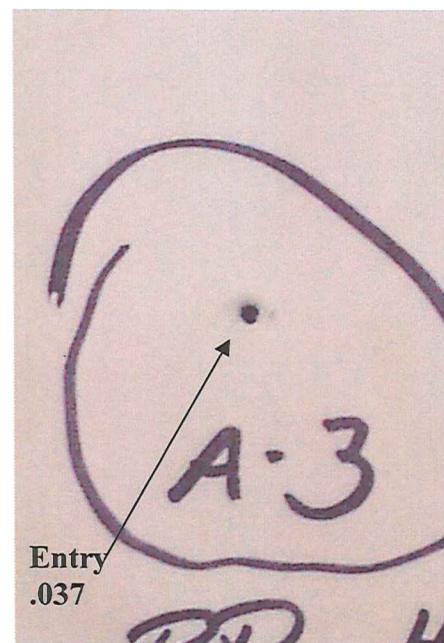
In every instance, the Dragonsshield HT® ERC immediately closed after penetration; not allowing light to be seen through the bullet hole.



.223 Win. 55 Grain Full Metal Jacket (FMJ)

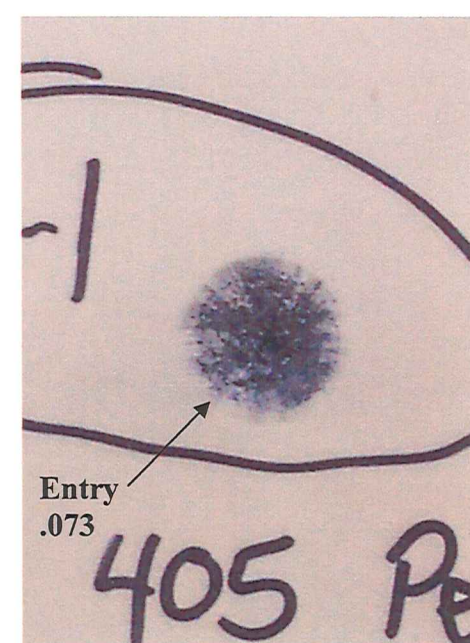


.223 Win. 60 Grain Full Metal Jacket (FMJ)



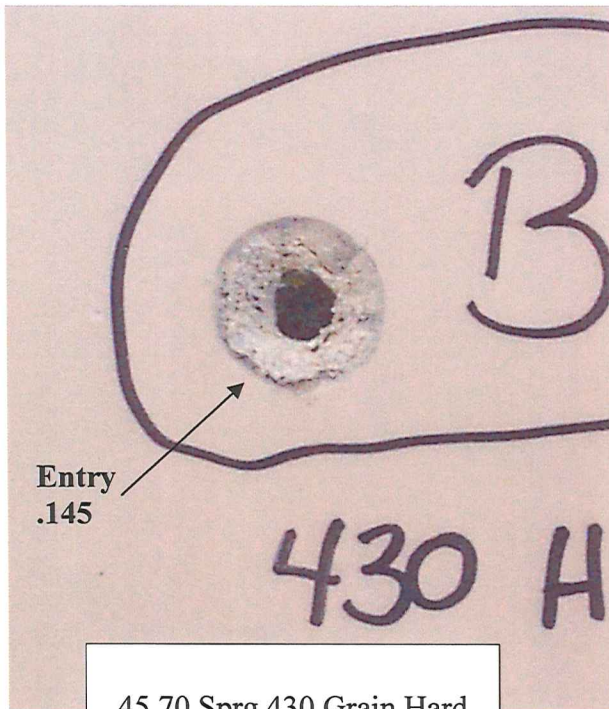
.223 Win.55 Grain Hunting Protected Point (PP)

No Exit

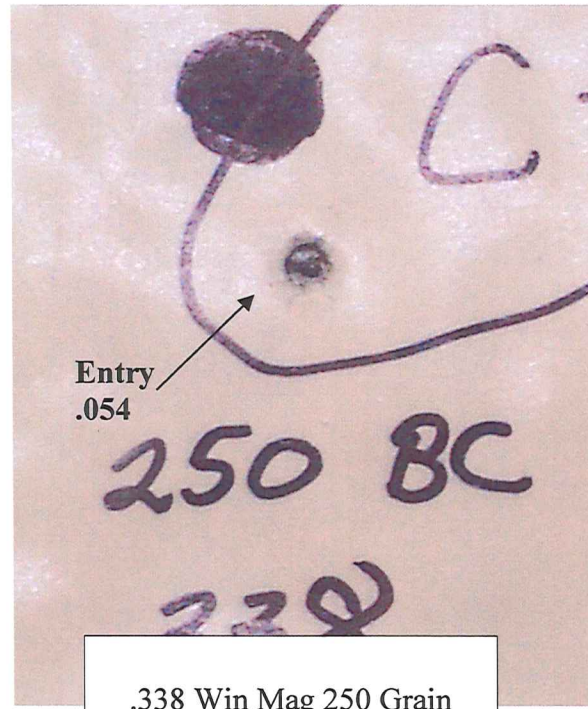
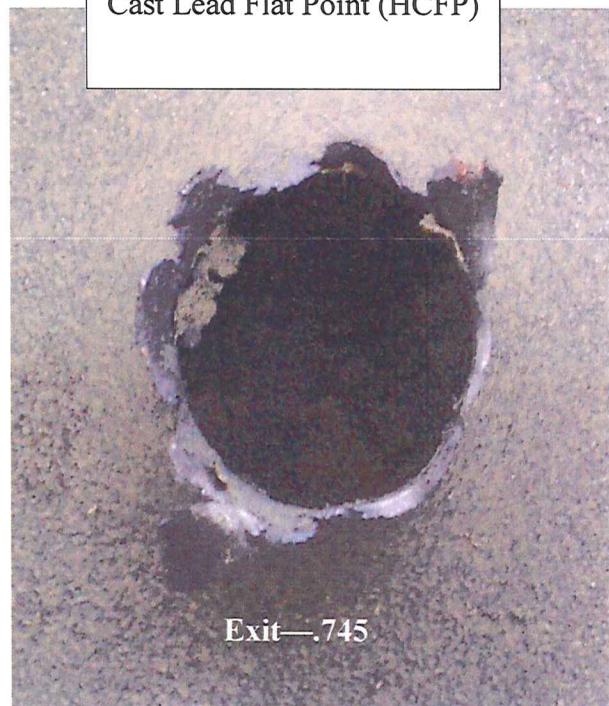


45.70 Sprg 405 Grain Jacketed Flat Point (FL) Penetrator

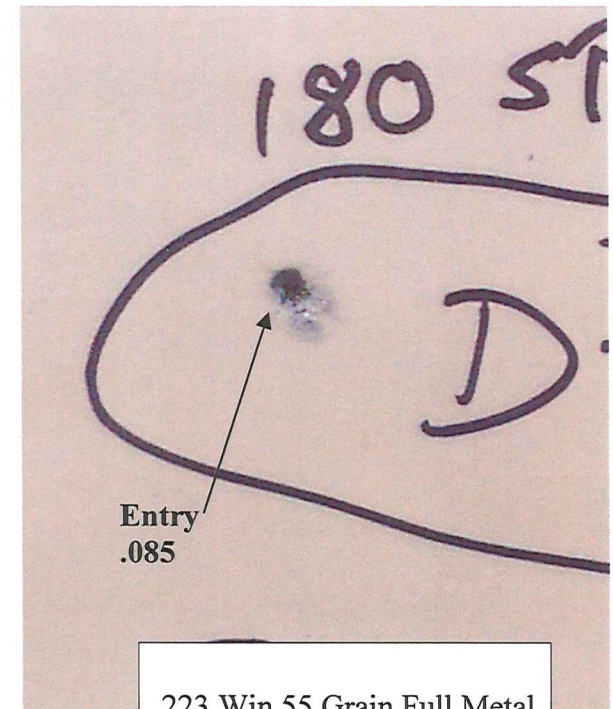
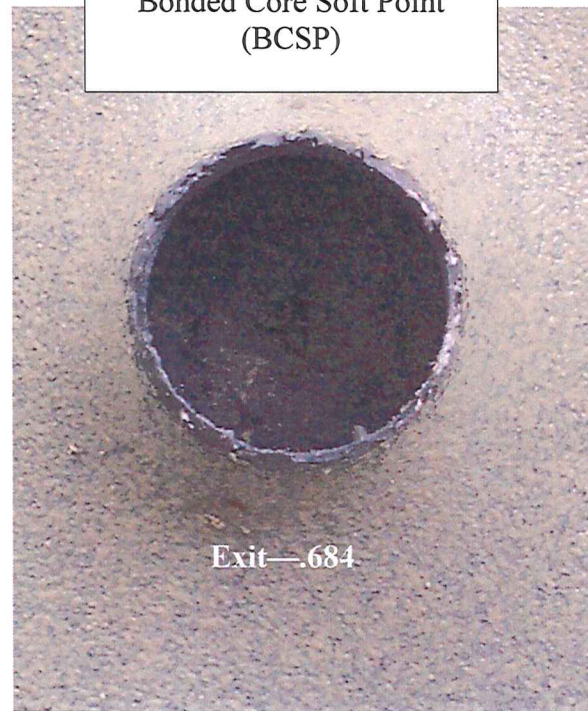




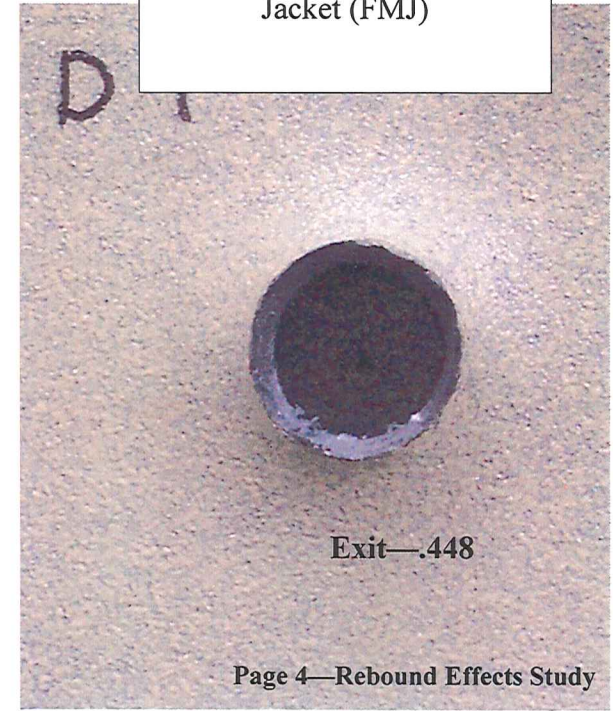
45.70 Sprg 430 Grain Hard
Cast Lead Flat Point (HCFP)

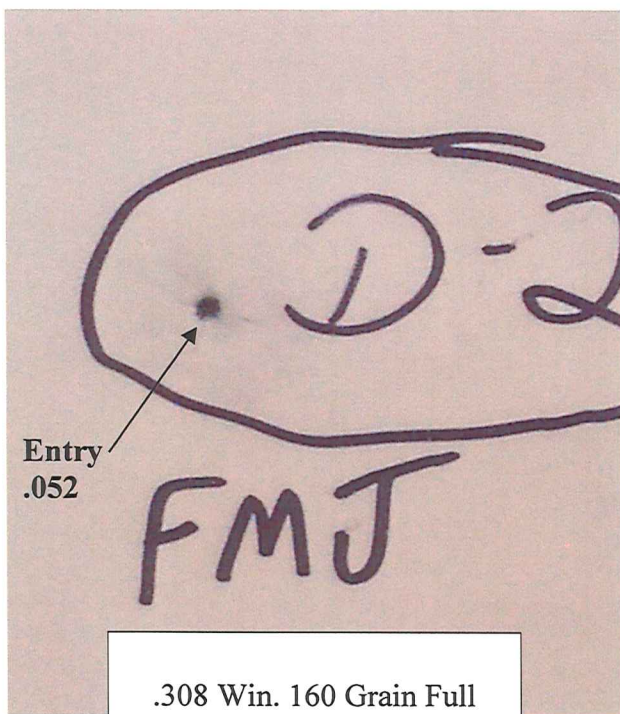


.338 Win Mag 250 Grain
Bonded Core Soft Point
(BCSP)

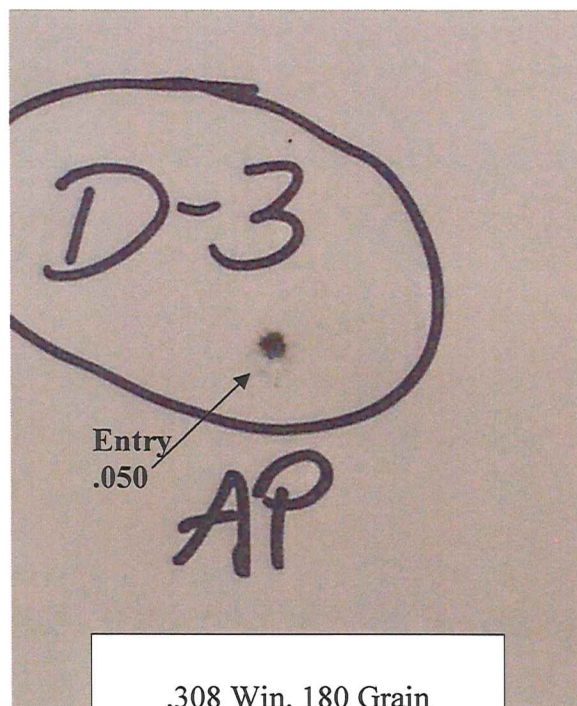


.223 Win.55 Grain Full Metal
Jacket (FMJ)

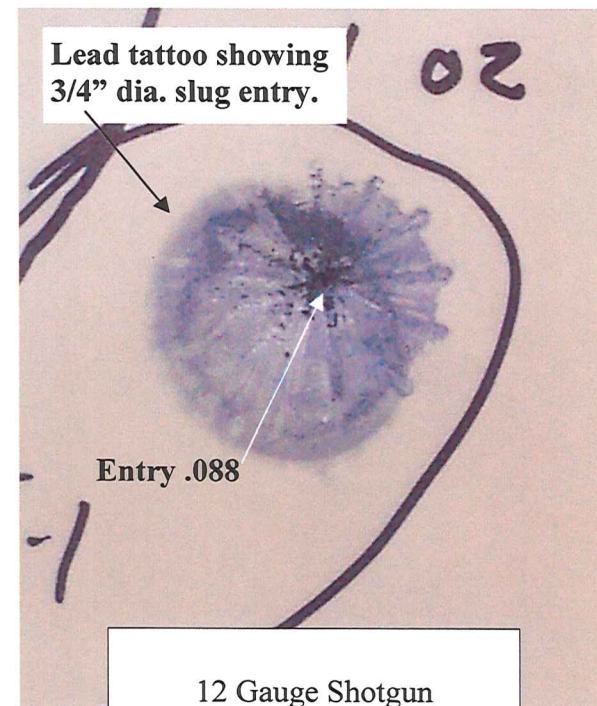




.308 Win. 160 Grain Full Metal Jacket (FMJ)

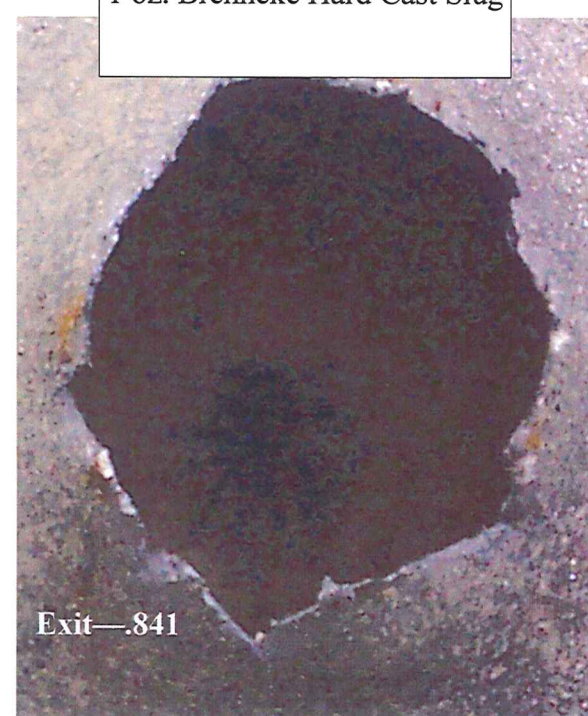


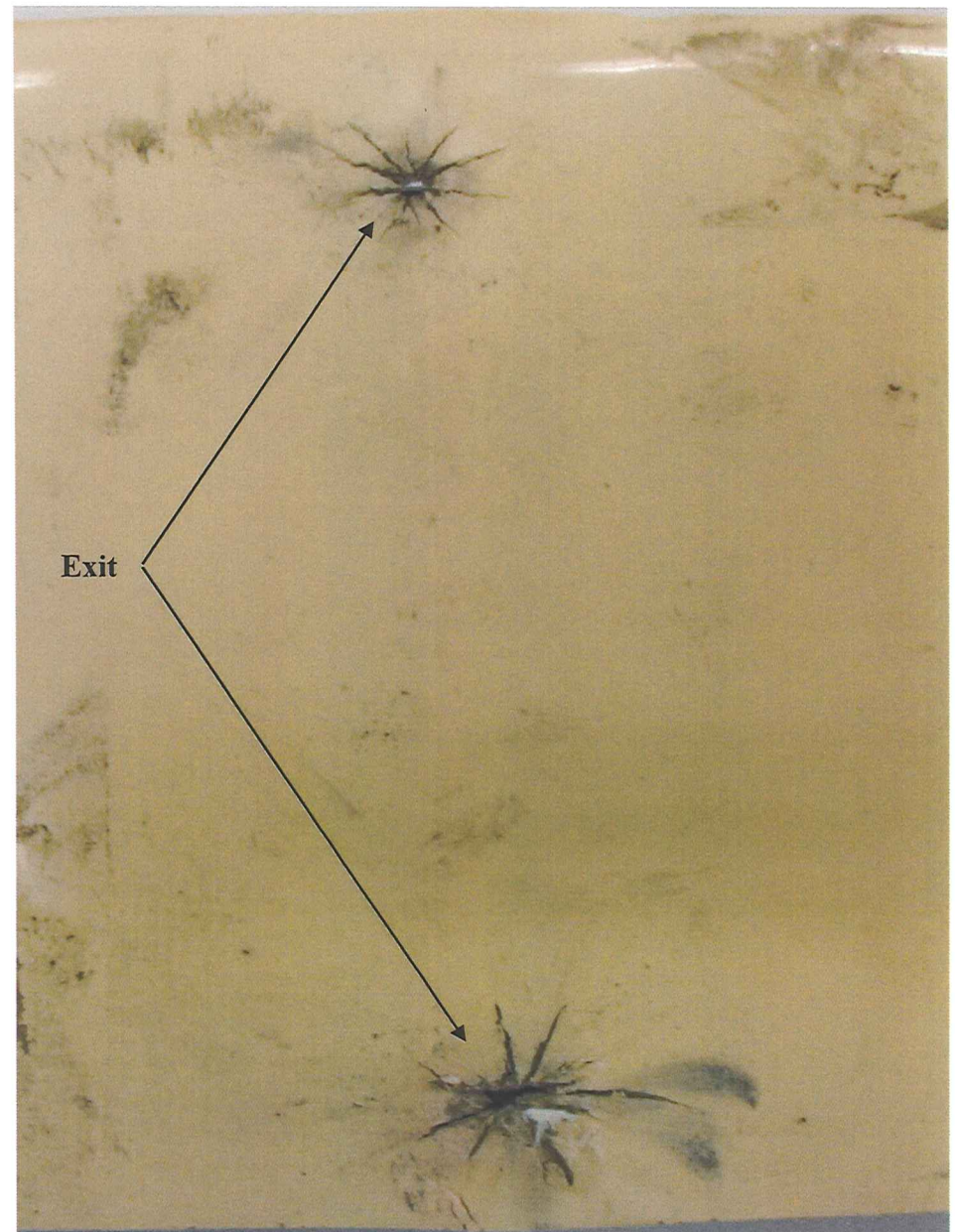
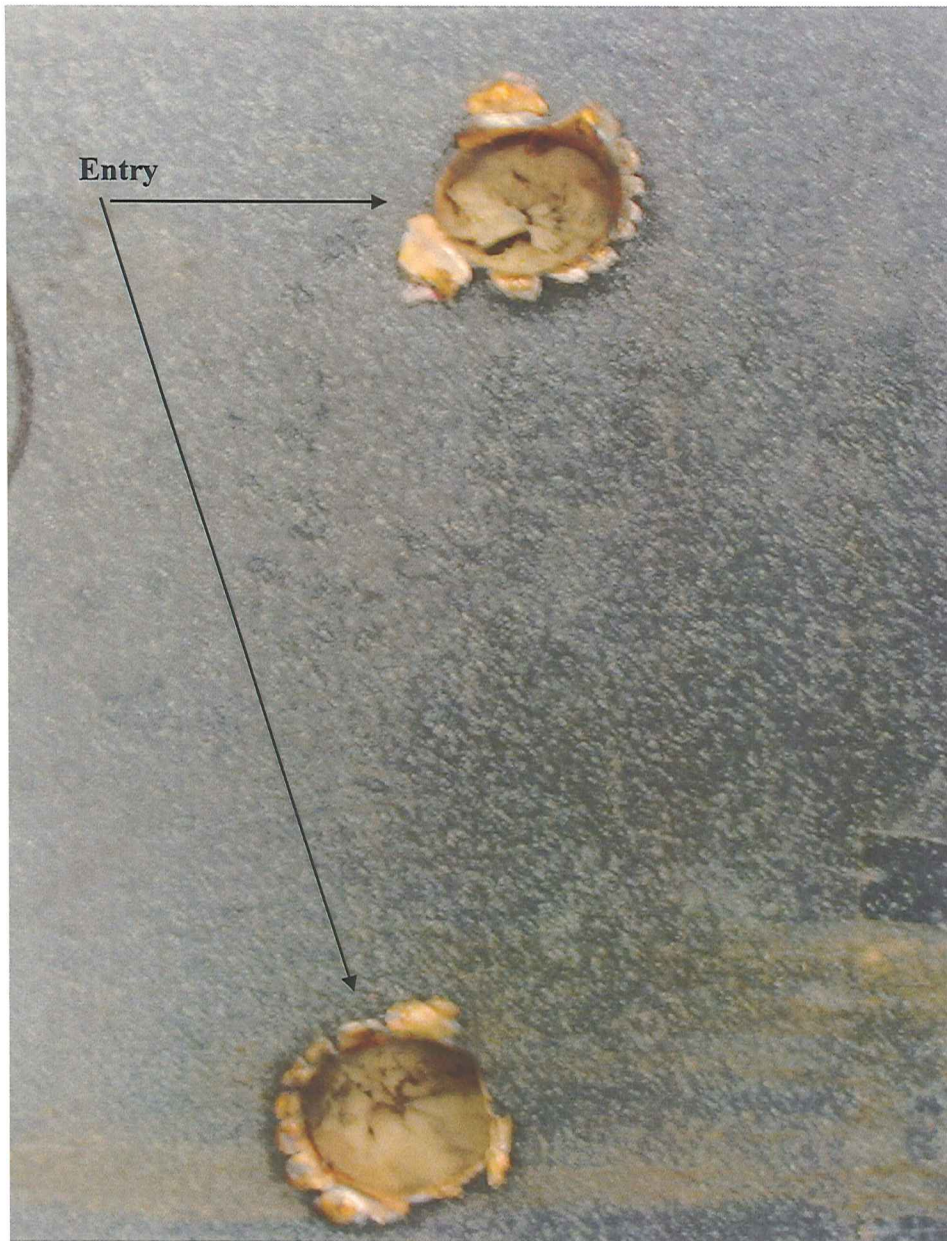
.308 Win. 180 Grain Armor Piercing (AP)



Lead tattoo showing 3/4" dia. slug entry.

12 Gauge Shotgun
1 oz. Brenneke Hard Cast Slug





Using 1/4" mild steel as the strike side of the panel, 50 caliber penetrating rounds were fired. the exit holes through the Dragonschild HT® were virtually closed (No light detected).

Leak Stop Test



10 Gauge Mild Unprotected Steel

Penetration: $\frac{3}{4}$ inch diameter, shotgun slug

Rebound leak test at 18 water column inches.

Water loss through penetration over a period of ten minutes: 100 gallons



10 Gauge Mild Steel Protected with $\frac{3}{4}$ inch (750 mils) Dragonshield HT

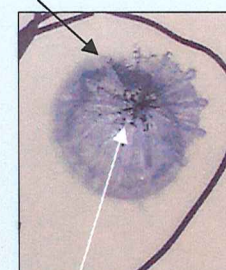
Penetration: $\frac{3}{4}$ inch diameter, shotgun slug

Rebound leak test at 18 water column inches.

Water loss through penetration over a period of ten minutes: 1.14 grams

12 Gauge Shotgun - 1 $\frac{3}{8}$ oz.
Brenneke Hard Cast Slug

Lead tattoo showing
 $\frac{3}{4}$ " dia. slug entry.



Entry Hole .088

Exit through the 10
gauge mild steel panel.



Exit Hole .841

(Entry & Exit shown actual size.)

Rebound Effects Study, Phase II will commence in November 2004. The "Snapback Rebound Effect" will be tested for its effectiveness and viability for pressure vessels. Testing will also encompass the development of new polymer formulations to completely self-seal against various chemicals, including hydrocarbons.



Phase II

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Snapback Rebound Effects Study Phase II*

Feasibility Test for Pressure Vessels

<p><u>Product:</u> DS-K5™</p> <p>Thickness (in.): <u>.800</u></p> <p><u>Metal:</u> High Hard Steel</p> <p>Thickness (in.): <u>.202</u></p> <p><u>Bullet:</u> .338 (BCSP)</p> <p>Exit Hole (in): <u>.460 (Avg.)</u></p> <p>Water Loss (Grams): <u>252</u></p> <p>Test Pressure (psi): <u>100</u></p> <p>Test Duration (minutes): <u>10</u></p> <p>Ambient Temperature during test shot(°F): <u>40 - 70</u></p> <p>Panel Temperature during test shot (°F): <u>40 - 70</u></p> <p>Test #: <u>001</u></p>	<p><u>Product:</u> DS Polyurea Base Coat™ (DSBC)</p> <p>Thickness (in.): <u>.800</u></p> <p><u>Metal:</u> Mild Steel</p> <p>Thickness (in.): <u>.250</u></p> <p><u>Bullet:</u> 50 Cal AP</p> <p>Exit Hole (in): <u>.525 (Avg)</u></p> <p><u>Test 1:</u></p> <p>Water Loss (Grams): <u>621</u></p> <p>Test Pressure (psi): <u>100</u></p> <p>Test Duration (minutes): <u>10</u></p> <p>Ambient Temperature during test shot(°F): <u>82°F</u></p> <p>Panel Temperature during test shot (°F): <u>130°F</u></p> <p>Test #: <u>002</u></p>
<p><u>Product:</u> Watershield-100™</p> <p>Thickness (in.): <u>.500</u></p> <p><u>Metal:</u> Mild Steel</p> <p>Thickness (in.): <u>.150</u></p> <p><u>Bullet:</u> .338 (BCSP)</p> <p>Exit Hole (in): <u>.475 (Avg.)</u></p> <p><u>Water Loss (Grams):</u> <u>0</u></p> <p>Test Pressure (psi): <u>100</u></p> <p>Test Duration (minutes): <u>10</u></p> <p>Ambient Temperature during test shot(°F): <u>40 - 70</u></p> <p>Panel Temperature during test shot (°F): <u> </u></p> <p>Test #: <u>003</u></p>	<p><u>Product:</u> Watershield-100™</p> <p>Thickness (in.): <u>.750</u></p> <p><u>Metal:</u> Mild Steel</p> <p>Thickness (in.): <u>.125</u></p> <p><u>Bullet:</u> .338 (BCSP)</p> <p>Exit Hole (in): <u>.500 (Avg.)</u></p> <p>Water Loss (Grams): <u>1171</u></p> <p>Test Pressure (psi): <u>100</u></p> <p>Test Duration (minutes): <u>10</u></p> <p>Ambient Temperature during test shot(°F): <u>40 - 70</u></p> <p>Panel Temperature during test shot (°F): <u> </u></p> <p>Test #: <u>004</u></p>

*Utilizing Standard Specialty Products, Inc. Polyureas.



Snapback Rebound Effects Study Phase II*

Feasibility Test for Pressure Vessels

<p>Product: Dragonshield HT ERC™</p> <p>Thickness (in.): <u>.880</u></p> <p>Metal: Mild Steel</p> <p>Thickness (in.): <u>.125</u></p> <p>Bullet: 12 Gauge 1 oz. Hard Cast Slug</p> <p>Exit Hole (in): <u>.890 (Avg.)</u></p> <p>Water Loss (Grams): <u>566</u></p> <p>Test Pressure (psi): <u>100</u></p> <p>Test Duration (minutes): <u>10</u></p> <p>Ambient Temperature during test shot(°F): <u>40 - 70</u></p> <p>Panel Temperature during test shot (°F): <u>40 - 70</u></p> <p>Test #: <u>005</u></p>	<p>Product: DS Polyurea Base Coat™ (DSBC)</p> <p>Thickness (in.): <u>.750</u></p> <p>Metal: Mild Steel</p> <p>Thickness (in.): <u>.250</u></p> <p>Bullet: .308 160 gr (FMJ)</p> <p>Exit Hole (in): <u>.450 (Avg.)</u></p> <p>Test 1:</p> <p>Water Loss (Grams): <u>0</u></p> <p>Test Pressure (psi): <u>100</u></p> <p>Test Duration (minutes): <u>10</u></p> <p>Ambient Temperature during test shot(°F): <u>40 - 70</u></p> <p>Panel Temperature during test shot (°F): <u>40 - 70</u></p> <p>Test 2:</p> <p>Water Loss (Grams): <u>0</u></p> <p>Test Pressure (psi): <u>200</u></p> <p>Test Duration (minutes): <u>10</u></p> <p>Ambient Temperature during test shot(°F): <u>40 - 70</u></p> <p>Panel Temperature during test shot (°F): <u>40 - 70</u></p> <p>Test #: <u>006</u></p>
<p>Product:</p> <p>Thickness (in.): _____</p> <p>Metal:</p> <p>Thickness (in.): _____</p> <p>Bullet:</p> <p>Exit Hole (in): _____</p> <p>Test 1:</p> <p>Water Loss (Grams): _____</p> <p>Test Pressure (psi): _____</p> <p>Test Duration (minutes): _____</p> <p>Ambient Temperature during test shot(°F): _____</p> <p>Panel Temperature during test shot (°F): _____</p> <p>Test 2:</p> <p>Water Loss (Grams): _____</p> <p>Test Pressure (psi): _____</p> <p>Test Duration (minutes): _____</p> <p>Ambient Temperature during test shot(°F): _____</p> <p>Panel Temperature during test shot (°F): _____</p> <p>Test #: _____</p>	<p>Product:</p> <p>Thickness (in.): _____</p> <p>Metal:</p> <p>Thickness (in.): _____</p> <p>Bullet:</p> <p>Exit Hole (in): _____</p> <p>Test 1:</p> <p>Water Loss (Grams): _____</p> <p>Test Pressure (psi): _____</p> <p>Test Duration (minutes): _____</p> <p>Ambient Temperature during test shot(°F): _____</p> <p>Panel Temperature during test shot (°F): _____</p> <p>Test 2:</p> <p>Water Loss (Grams): _____</p> <p>Test Pressure (psi): _____</p> <p>Test Duration (minutes): _____</p> <p>Ambient Temperature during test shot(°F): _____</p> <p>Panel Temperature during test shot (°F): _____</p> <p>Test #: _____</p>

*Utilizing Standard Specialty Products, Inc. Polyureas.

Specialty Products, Inc
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Phase III

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Snapback Rebound Effects Study Phase III*

Feasibility Test for Pressure Vessels

Product:

Dragonshield HT ERC™ (Composite)

Layer 1: .150 Durashield HT ERC™

Layer 2: .250 Ceramic Spheres

Layer 3: .475 Durashield HT ERC™

Thickness (in.): .875**Metal:** High Hard SteelThickness (in.): .202**Bullet:** 50 Cal. Frangible (frag.)Exit Hole (in): .450 (Avg)Water Loss (Grams): 1109Test Pressure (psi): 100Test Duration (minutes): 10Ambient Temperature during test shot(°F): 40 - 70Panel Temperature during test shot (°F): 40 - 70Test #: PH3-001**Product:**

DS Polyurea Base Coat™ (DSBC) (Composite)

Layer 1: .125 DSBC

Layer 2: .250 PB-I

Layer 3: .375 DSBC

Thickness (in.): .750**Metal:** Mild SteelThickness (in.): .250**Bullet:** .338 (BCSP)Exit Hole (in): .590 (Avg)Water Loss (Grams): 0Test Pressure (psi): 100Test Duration (minutes): 10Ambient Temperature during test shot(°F): 40 - 70Panel Temperature during test shot (°F): 40 - 70Test #: PH3-002**Product:**

DS Polyurea Base Coat™ (DSBC) (Composite)

Layer 1: .125 DSBC

Layer 2: .250 PB-I

Layer 3: .375 DSBC

Thickness (in.): .750**Metal:** Mild SteelThickness (in.): .250**Bullet:** .308 160 Grain (FMJ)Exit Hole (in): .450 (Avg)Water Loss (Grams): 0Test Pressure (psi): 100Test Duration (minutes): 10Ambient Temperature during test shot(°F): 40 - 70Panel Temperature during test shot (°F): 40 - 70Test #: PH3-003**Product:**

DS Polyurea Base Coat™ (DSBC) (Composite)

Layer 1: .125 DSBC

Layer 2: .250 PB-II

Layer 3: .375 DSBC

Thickness (in.): .750**Metal:** Mild SteelThickness (in.): .250**Bullet:** .308 160 (FMJ)Exit Hole (in): .410 (Avg)Test 1: Water Loss (Grams): 0Test Pressure (psi): 100Test Duration (minutes): 10Ambient Temperature during test shot(°F): 30 - 50Panel Temperature during test shot (°F): 70Test 2: Water Loss (Grams): 0Test Pressure (psi): 200Test Duration (minutes): 10Ambient Temperature during test shot(°F): 30 - 50Panel Temperature during test shot (°F): 70Test #: PH3-004

*Using unique spray Polymers as well as barrier layers and composites.



Snapback Rebound Effects Study Phase III*

Feasibility Test for Pressure Vessels

Product:

DS Polyurea Base Coat™ (DSBC) (Composite)

Layer 1: .100 DSBC

Layer 2: .200 PB-II

Layer 3: .375 DSBC

Thickness (in.): .675

Metal: Mild Steel

Thickness (in.): .250

Bullet: 50 Cal. AP

Exit Hole (in): .540 (Avg)

Water Loss (Grams): 0

Test Pressure (psi): 100

Test Duration (minutes): 10

Ambient Temperature during test shot(°F): 82

Panel Temperature during test shot (°F): 130

Test #: PH3-005A

Product:

DS Polyurea Base Coat™ (DSBC) (Composite)

Layer 1: .115 DSBC

Layer 2: .220 PB-II

Layer 3: .340 DSBC

Thickness (in.): .675

Metal: Mild Steel

Thickness (in.): .250

Bullet: 50 Cal. AP

Exit Hole (in): .620 (Avg)

Water Loss (Grams): 150.3

Test Pressure (psi): 100

Test Duration (minutes): 10

Ambient Temperature during test shot(°F): -30

Panel Temperature during test shot (°F): -30

Test #: PH3-005B

PH3-005 Test A & B were sprayed side by side, at the same, time to achieve a similar thickness. The only difference was the temperature of the panels at time of test shot.

Product:

DS Polyurea Base Coat™ (DSBC) (Composite)

Layer 1: .110 DSBC

Layer 2: .300 PB-I

Layer 3: .280 DSBC

Thickness (in.): .690

Metal: Mild Steel

Thickness (in.): .250

Bullet: 50 Cal. AP

Exit Hole (in): .540 (Avg)

Water Loss (Grams): 12.6

Test Pressure (psi): 100

Test Duration (minutes): 10

Ambient Temperature during test shot(°F): 82

Panel Temperature during test shot (°F): 130

Test #: PH3-006

Product:

Layer 1: .120 DSBC

Layer 2: .330 PB-II

Layer 3: .740 DSBC

Thickness (in.): 1.190

Metal: Mild Steel

Thickness (in.): .250

Bullet: 50 Cal. AP

Exit Hole (in): .610 (Avg)

Water Loss (Grams): 0

Test Pressure (psi): 100

Test Duration (minutes): 10

Ambient Temperature during test shot(°F): -30°

Panel Temperature during test shot (°F): -30°

Test #: PH3-007

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Phase III Snapback/Rebound (resealing) Testing

*Composite was tested at 100 and 200psi pressure under same conditions and duration also resulting in no water loss

Products Used/ thickness (in.)	Dragonshield /.150	DSBC/.125	DSBC/.125	DSBC/.125	DSBC/.100	DSBC/.115	DSBC/.110	DSBC/.120
Layer 1								
Layer 2	Ceramic Spheres/.250	PB-I/.250	PB-I/.250	PB-II/.250	PB-II/.200	PB-II/.220	PB-I/.300	PB-II/.330
Layer 3	Dragonshield /.475	DSBC/.375	DSBC/.375	DSBC/.375	DSBC/.375	DSBC/.340	DSBC/.280	DSBC/.740
Total composite thickness (in.)	.875	.750	.750	.750	.675	.675	.690	1.190
Metal/thickness (in.)	HHS/.202	Mild Steel/ .250	Mild Steel/ .250	Mild Steel/ .250	Mild Steel/ .250	Mild Steel/ .250	Mild Steel/.250	Mild Steel .250
Bullet <i>All shot at a 30 foot standoff</i>	50 Cal Frag	.338 (BCSP)	.308 160 grain (FMJ)	.308 160 grain (FMJ)	50 Cal AP	50 Cal AP	50 Cal AP	50 Cal AP
Exit Hole (in.)	.450	.590	.590	.410	.540	.620	.540	.610
Water Loss (Grams)	1109	0	0	0	0	150.3	12.6	0
Test Pressure (psi)	100	100	100	100/200*	100	100	100	100
Test Duration (minutes)	10	10	10	10	10	10	10	10
Ambient Temperature during test shot (°F)	40-70	40-70	40-70	30-50	82	-30	82	-30
Panel Temperature during test shot (°F)	40-70	40-70	40-70	70	130	-30	130	-30
TEST #	PH3-001	PH3-002	PH3-003	PH3-004	PH3-005A	PH3-005B	PH3-006	PH3-007

