Comparison of backing materials used in the testing of ballistic body armour

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Introduction

The ballistic testing of personal body armour against a standard (NIJ, HOSDB, VPAM etc) has typically been performed with the armour mounted on a block of modelling clay e.g. Roma™ Plastilina No1. To aid in the development of alternative backing materials for the testing of ballistic protective armour, a comparison trial was conducted comparing the response of three different backings, Roma™ Plastilina No 1, 10 % (by mass) gelatine and a synthetic gel (SEBS).

Aim

To understand the response of various backing materials to a non-perforating ballistic impact on a body armour.

Method

Each backing material was tested 50 times with two types of ammunition, 9 mm FMJ and 0.357" JSP, using a standardised ballistic test packs (400 mm x 400 mm) and test pattern, Figure 1.

For each shot, the velocity and recorded back face signature (BFS) was recorded.

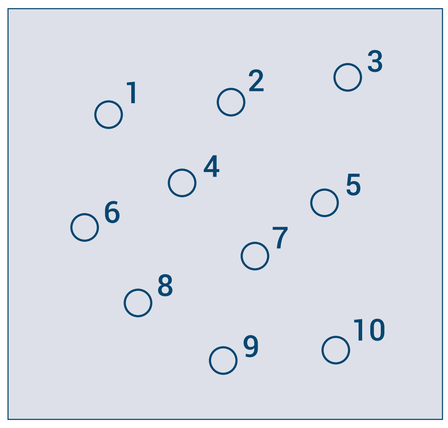

Figure 1 Shot layup

Results

Summary data is presented in tables 1 and 2 for each medium for individual test pack by calibre and for all shots by calibre. Data presented is limited to mean velocity and mean BFS for each medium.

		Individual Test Pack				All Shots		
		Velocity (ms^{-1})		BFS (mm)			Velocity (ms^{-1})	BFS (mm)
Backing	Pack	Mean	SD	Mean	SD			
SEBS	1	367.3	8.04	37.98	4.08	Mean	368.7	37
	2	367.9	14.12	35.94	5.62	SD	12	5
	3	365.3	5.48	35.6	4.66	Min	354	30
	4	374.3	16.08	37.38	5.15	Max	402	48
						C.V.	3.27%	13.62%
Roma	1	373.7	2.92	22.88	2.33	Mean	374.2	23.45
	2	374.7	2.11	22.74	2.52	SD	2.27	3.08
	3	374.4	2.59	22.57	3.39	Min	368	17.6
	4	373.9	1.73	24.06	3.87	Max	378	30.9
	5	374.3	2.21	24.98	2.92	C.V.	0.61%	13.13%
Gel	1	362.4	2.08	32.20	4.86	Mean	362.9	31.39
	2	362.4	4.44	29.08	3.33	SD	2.22	6.03
	3	362.7	3.05	27.15	4.09	Min	358	21.53
	4	364.1	7.20	39.04	8.34	Max	369	57.69
	5	363.0	2.81	29.73	3.48	C.V.	0.61%	19.22%

Table 1 Summary data for 9mm FMJ test shots

		Individual Test Pack				All Shots		
		Velocity (ms^{-1})		BFS (mm)			Velocity (ms^{-1})	BFS (mm)
Backing	Pack	Mean	SD	Mean	SD			
SEBS	1	381.1	10.1	41.9	6.41	Mean	388.8	40.54
	2	388.7	6.54	38.7	4.75	SD	10.22	5.56
	3	386.6	7.51	36.9	2.43	Min	362	31.92
	4	392.9	9.75	39.5	5.73	Max	411	52.82
	5	394.9	9.35	41.9	5.29	C.V.	2.62%	13.71%
Roma	1	391.9	3.57	24.50	2.96	Mean	391.2	25.27
	2	390.5	2.01	25.05	3.72	SD	2.59	3.57
	3	391.4	2.01	23.66	4.04	Min	388	18.9
	4	392.1	3.18	26.25	3.21	Max	400	32.5
	5	390.9	1.86	26.91	3.54	C.V.	0.66%	14.13%
Gel	1	392.9	7.91	7.91	4.73	Mean	392.1	44.36
	2	392.4	6.65	6.65	3.11	SD	2.29	8.47
	3	392.1	9.89	9.89	3.08	Min	387	31.54
	4	390.3	9.10	9.10	3.23	Max	397	67.31
	5	392.9	10.35	10.35	8.78	C.V.	0.58%	19.10%

Table 2 Summary data for 0.357" JSP test shots

Conclusion

This preliminary assessment of the data indicated that ballistic gelatine was the most variable test medium, whereas the Roma Plastilina and SEBS gel show similar levels of variance. However, the SEBS gel measured a greater BFS than Plastilina.

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