
 <p>LORICA RESEARCH LTD</p>	<p>Not Restricted Body Armour Vests, Heavier and Stiffer, but Safer. August 2007</p>	<p>Lorica Research Ltd The Laboratory Norton Barracks NORTON Worcester WR5 2PP United Kingdom Tel +44 1905 355 110</p>
--	--	--

Body Armour Vests

Heavier and Stiffer, but Safer.

Digby Dyke, Lorica Research Ltd.

August 2007

	<p>Not Restricted Body Armour Vests, Heavier and Stiffer, but Safer. August 2007</p>	<p>Lorica Research Ltd The Laboratory Norton Barracks NORTON Worcester WR5 2PP United Kingdom Tel +44 1905 355 110</p>
---	--	--

Body Armour Vests

Heavier and Stiffer, but Safer.

Digby Dyke, Lorica Research Limited

August 2007


From the end of 2007 newly qualified body armour vests sold to UK police will be heavier, stiffer and somewhat less comfortable to wear than in recent years; and will cost more to buy. However, they will be safer to wear. So what are the reasons for all this?

I have worked in the body armour industry around the world for sixteen years. There have been very many changes in that time. In the UK what once was a relatively small market poorly regulated is now a well-controlled sophisticated business worth many millions of pounds. Now, most UK operational police officers are provided with body armour, and the police services as customers are much better informed about what to buy. Armour materials technologies have advanced and the Home Office Scientific Development Branch publication *HOSDB Body Armour Standards for UK Police (2007)* soon to be published will provide the most comprehensive set of guidelines and compliance testing procedures for body armour anywhere in the world.

While changes have meant a marked step forward in providing protection for police officers some of the effects may *appear* to be a step backward. These are to do with the physical nature of body armour affecting comfort.

Looking back just five years to May 2002 there were 11 qualified body armour vests recorded on the PSDB Body Armour Database for what has become the most often defined threat level - Handgun Level 1A plus Knife-Resistance Level 2 (HG1A + KR2). This database now records only body armour qualified to the new HOSDB 2007 Standard, which, although not yet published, has been in use for some months. By August 2007 there were 7 HG1A + KR2 body armour vests on the HOSDB Database newly qualified to the HOSDB 2007 Standard. More are on the way.

In Table 1 below, the areal densities of the armour constructions in these newly qualified vests is compared with the areal densities of the body armour constructions of five years ago. The term *areal density* when describing armour means the mass of the armour in relation to its surface area. In this case it is one square metre of an armour construction expressed in kilos per square metre (kg/m²). This is one, but not the most important, way of comparing one body armour construction with another.

	<p>Not Restricted Body Armour Vests, Heavier and Stiffer, but Safer. August 2007</p>	<p>Lorica Research Ltd The Laboratory Norton Barracks NORTON Worcester WR5 2PP United Kingdom Tel +44 1905 355 110</p>
---	--	--

Areal Density of Body Armour HOSDB HG1A + KR2	In the year 2002 kg/m ²	In the year 2007 kg/m ²
Average	6.80	7.95
Lowest	5.84	7.02
Highest	7.30	10.04

Table 1

In Table 2 below, the weights of the newly qualified finished body armour vests referred to above are compared with the weights of vests of five years ago. The weights in Table 2 are for a theoretical large-sized vest having a protection area over the body of 0.4m². Smaller vests for smaller officers will of course be lighter and larger vests heavier as the case may be. The difference in weights between different manufacturer's models of body armour vests also is not necessarily the most important comparison to make.


Weight of Body Armour Vests HOSDB HG1A + KR2	In the year 2002 kg (lbs)	In the year 2007 kg (lbs)
Average	2.72 (5.99)	3.18 (7.01)
Lowest	2.43 (5.35)	2.80 (6.17)
Highest	2.92 (6.44)	4.16 (9.17)

Table 2

Then there is stiffness, which also has increased in cases where protection from stabbing with spikes is included with the consequent necessity to include denser materials preventing the penetration of spikes as well as knives. All 7 of the above mentioned newly qualified body armour vests are in fact also qualified to protect against spikes. All, therefore, are in fact qualified to HOSDB SP2 as well as to HG1A + KR2, unlike the 11 vests referred to of five years ago.

In summary, newer vests referred to are *on average* 17% heavier than those of five years ago; and if spike protection is required they are somewhat stiffer as well.

Comfort inevitably will be affected by these changes, but by much less than might be expected. Other changes in the industry mean that comfort is improving through better fitting and pattern graduation enabling greater size ranges. And there is better styling and more understanding of best-positioning for equipment pouches and the like. As a result heavier armours are not at all necessarily the least comfortable, and more stiffness does not necessarily lead to less comfort either. In the initial stages armour areal density, vest weight and stiffness are not so important to compare. It is

	<p>Not Restricted Body Armour Vests, Heavier and Stiffer, but Safer. August 2007</p>	<p>Lorica Research Ltd The Laboratory Norton Barracks NORTON Worcester WR5 2PP United Kingdom Tel +44 1905 355 110</p>
---	--	--

an objective wearer trial that is the best way to compare body armour. It is the *only* way to determine comfort in the selection of body armour.


A more common complaint than weight and stiffness by wearers of body armour is excessive body heat. There have been several, sometimes ingenious, ideas developed to help wearers to feel cooler. Many work to a degree for a short while after donning the armour; but perhaps none work better and longer than ‘moisture wicking’ fabrics or simple ventilation provided by use of ‘spacer’ fabrics in the body armour linings.

By far the most important and significant changes have been with regard to increasing reliability and ensuring consistency of protection performance. This is a result of substantially more stringent manufacturing control by industry and more comprehensive requirements for compliance by HOSDB. The goal has been to ensure that, body armour reaches a specific level of performance and maintains it *fully* throughout its entire life. Changes to raw materials (including changes of suppliers) and changes to body armour constructions and manufacturing methods for whatever reason should not take place after qualification – or at least if they do the armour is subjected to new compliance testing.

Throughout a supply contract and for the life of the equipment there is a specific responsibility demanded of the manufacturer by HOSDB for ensuring that the performance level of the qualified armour *is* maintained, and in the new HOSDB Standards there is advice given to police customers to ask for quality assurance from suppliers and very specific guidance and procedures for doing it.

There are very good reasons for this tightening of practices in the body armour industry and the introduction of more exacting standards. Not least the case of the change and reduction in performance of body armour vests manufactured by the body armour manufacturer, Second Chance Armor Inc., in which the material Zylon® was used. This material gradually lost its bullet-resistant performance due to ageing. Serious injury and loss of life of police officers in the US was attributed to this cause. The subsequent bankruptcy of the then Second Chance Armor Inc.¹ and lawsuits against the Company and criminal proceedings against senior executives followed. The US National Institute of Justice subsequently has banned the use of Zylon® material in body armour for US police².

In the UK, less serious consequences of the failure of body armour vests to maintain performance occurred in the case of certain vests manufactured by the Northern Ireland body armour manufacturer, Highmark Manufacturing Company Ltd. In this case, one of several that I have investigated, no police officer was killed or injured, but the vests nevertheless when tested long after being sold in thousands to UK police customers were found to have been changed after compliance testing and subsequently had reduced performance³. The consequences of this case undoubtedly contributed to the demise of this vest manufacturer’s business also.

	<p>Not Restricted Body Armour Vests, Heavier and Stiffer, but Safer. August 2007</p>	<p>Lorica Research Ltd The Laboratory Norton Barracks NORTON Worcester WR5 2PP United Kingdom Tel +44 1905 355 110</p>
---	--	--

Other cases that I have investigated include body armour vests sold in Iraq filled with carpet material and not body armour material, and stab vests manufactured and sold in the UK falsely described as complying with PSDB Standards, and vests advertised with ‘incredible’ protection properties on the Internet auction site, eBay. I saw one described as “*100% stab proof & will stop small arms fire from most standard rifles. It will also protect from grenade & artillery shell blasts*“. This particular vest was in fact nothing more than a standard basic military ‘fragmentation’ vest quite incapable of *any* of the remarkable protection qualities attributed to it by its vendor.

Perhaps the most significant of all changes with the new HOSDB standards is the amount of testing that body armour is subjected to before qualification. It has virtually trebled – more test shots, more test stabs, more armour samples subjected to testing, and so on – and in addition to this the methods of evaluating test data have changed to enable much more qualitative assessment. Unfortunately the cost of compliance testing has also more or less trebled and the material content of body armour has increased. With these and new requirements for greater quality assurance by manufacturers and periodic re-qualification inevitably there will be price increases.

Altogether the standards and quality of body armour supplied to UK police is high and improving, thanks to the recent work of many responsible people in the manufacturing industry as well as ACPO and HOSDB. Some would say the quality is unnecessarily high, commenting that comfort and cost is affected too much. *I* would not say that. Whichever way one looks at it, there has to be a higher cost for the best.

Digby Dyke

¹ Armor Holdings acquired all of the assets of Second Chance, including substantially all intellectual property, free and clear of all liens, claims and encumbrances, and assumed certain trade liabilities. The acquisition specifically excluded any Zylon® or Zylon® related assets and all outstanding claims related to Zylon®, including those related to Ultima, Ultimax, and Triflex model vests. The United States Bankruptcy Court, Western District of Michigan, confirmed the transaction on Wednesday, July 27, 2005.

² NIJ Body Armor Standard Advisory Notice #01-2005, AUGUST 24, 2005, Poly-*p*-phenylene benzobisoxazole (PBO or Zylon®). Copies of this can be downloaded from http://www.ojp.usdoj.gov/bvpbasi/docs/08_18_05BAI_AdvisoryNotice.doc

³ Investigation into the Performance of Models KCW223 and KCW110 Body Armour Vests Manufactured by Highmark Manufacturing Company Ltd. Report of Digby Dyke and Robert Knight, Lorica Research Ltd. 7th April 2004. Published 1st September 2007. From 1st September 2007 copies of this report can be downloaded from <http://www.sorensencentre.org.uk/news.asp>