



Civilian Armoured Vehicles (CAVs) - The Essence of Protection, Discretion and Mobility - Part 2: Protection – Threats, Independent Verification and Standards, and Design Issues.

In the second of a four part series, Rob Getreu, Senior Consultant with the leading international civilian armoured vehicle consultancy, **Armoured Consulting**, discusses a number of aspects relating to the protection provided in civilian armoured vehicles.

Part 2: Protection – Threats, Independent Verification and Standards, and Design Issues.

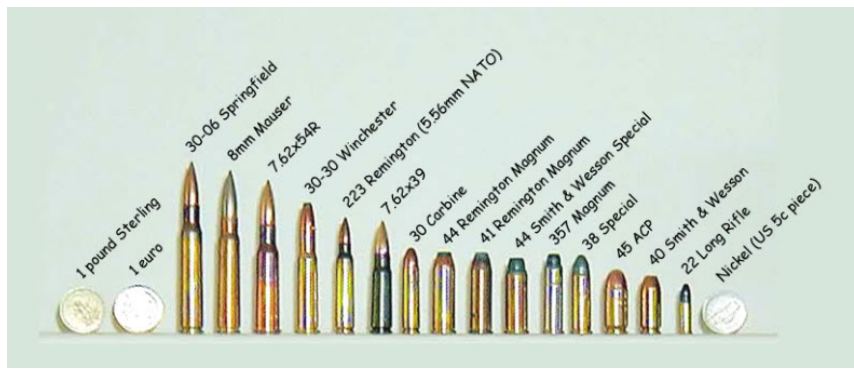
From my many years working with users, buyers and sellers of civilian armoured vehicles, I have seen and heard of many protection design propositions, potential threats, terminology and labels. To be sure, for anyone new to this industry, it can be very confusing and daunting.

As such, my aim with this article is to provide a “first principles” based review of the key areas that are important for non-experts to better understand the protection aspects of Civilian Armoured Vehicles (CAV). Although it’s certainly tempting to go in depth on this crucial topic, this article will not be a thorough technical review and analysis, as that would tend to cross into the sphere of commercial in confidence or even classified information, which would be best provided at another time and forum.

Threats – Ballistic and Blast

Probably the best way to begin to understand what protection a CAV should provide, is to have a better understanding of the threats that are commonly faced in hostile environments.

From a first principles perspective, these threats can be broken into two major areas. The first area is ballistic, i.e. bullets of various calibres, and the second area is blast, i.e. explosions – with or without fragmentation.



1. Ballistic Threats – commonly, but certainly not exclusively, the ballistic threats are from handguns (9mm, 0.44mm and 0.357mm calibres) and various assault rifles (39mm, 45mm and 51mm calibres). There are also the more lethal API rounds (armour piercing) and larger military calibres, e.g. 50mm. While commonly seen in military theatres, these are generally outside the protection brief of CAVs.
2. Blast Threats – Commonly these are IEDs (Improvised Explosive Devices). They generally use HME (Home Made Explosives based on such common compounds as ammonium nitrate) or military grade explosives such as PETN (plastic explosive). These devices are then generally engineered as either blast only, or they are packed with fragmentation for additional lethality. They can also be shaped charges, which provide an additional level of threat.



It is preferable to carefully match the protective capability of the CAV to the user's assessed threats, rather than merely buying what a seller has to offer. In this way, the vehicle is better suited to the operating conditions and meets the user's protection requirements, without adversely impacting on both mobility (more armour generally makes for a heavier vehicle) and budget (the higher the threat level, the higher the cost of the vehicle). Consider also, that some users may decide to always build to their highest assessed threat (rather than common threat) and so enable all their vehicle assets to be deployed to any of their operating theatres.

Once the threats have been assessed, a user can then better interact with the supplier as to the level of protection to be built into the CAV.

Independent Verification and Standards – Ballistic and Blast

While quantitatively the level of protection provided by the armour design (both transparent and opaque) can be built into the CAV, users need to better understand the qualitative aspects of the specific design being used. To do so, it is recommended that the CAV being procured be based on a design that has been **independently certified**. This process involves the uparmouring manufacturer producing a test vehicle that is then sent to an independent test

company where it is subjected to specific and repeatable tests that can verify (or reject) both the ballistic and blast protection claims.

If you're in any way involved in new engineering designs, then you likely already know that test, evaluation and verification are essential parts of product development. While an uparmouring manufacturer may claim that the vehicle will protect against a specific threat, it is imperative for passenger safety and duty of care that the buyer is satisfied that the claims have been independently verified. Further, the entire vehicle needs to be tested and not simply a sample or coupon of the armoured steel or glass to be used in production.

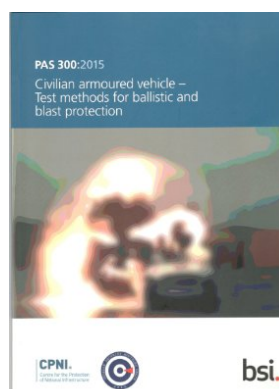
There are a number of reputable international organisations that conduct such tests and provide written reports. These include, but are not limited to, QinetiQ, iABG and Beschussamt. The written reports should be readily available for review by any legitimate buyer.

It should be noted that a number of companies conduct ballistic testing on small samples/coupons of armoured steel or glass. While it is imperative to conduct raw materials production batch verification, it does not provide for full vehicle system testing.

Importantly, these independent tests are conducted with reference back to the international standards. For civilian armoured vehicles, the VPAM BRV (Bullet Resistant Vehicles) 2009 provides the most commonly used European standard for ballistic testing of full vehicle systems. It is an improvement from the older 1999 standard and is commonly used as a yardstick by uparmouring manufacturers and test agencies alike.

There are a number of other standards that are commonly referred to in the market. A few of note are:

1. **NIJ: National Institute of Justice:** This is a US standard commonly used to test body armour and vests. While some companies quote this for a vehicle, it is not designed or scoped to provide robust testing standards for full vehicles.
2. **STANAG 4569:** This is a NATO standard commonly used for light armoured military vehicles but over time has also been used for testing of CAVs. It was formulated to provide standards for strikes from kinetic energy (relating to ballistics), grenade and mine blasts under the vehicle and artillery off the side of the vehicle.
3. **VPAM ERV (Explosive Resistant Vehicles) 2010:** This standard provides a structured approach for the explosive (PETN) testing of the underside, roof and sides of civilian armoured vehicles, primarily built to the BRV 2009 standards.



4. **PAS300:2015:** This is the new British Standard that defines test

methods for assessing ballistic and/or blast performance in civilian (i.e. civilian/non military) armoured vehicles (CAVs). It defines test levels for ballistic impact (including handgun, shotgun and rifle), side blast, under vehicle blast and roof blast.

5. **VSAG15:** While not specifically a standard, this is the Civilian Armoured Vehicle Handbook that is used by the member nations who form the International Vehicle Security Armoured Group. It provides guidance to those government agencies in relation to issues of vehicle specifications, procurement and fleet management, and testing (ballistic, explosive, automotive and enhanced). Note that this is generally not a publicly available document.

Commonly, you still see the terms “B6” or “B7”. It should be understood that **these terms relate only to ballistic and not to blast protection.** Further, they really are specific to sample/coupon testing of transparent armour only and not for a vehicle system as a whole. Should a vehicle be marketed as “B6” or “B7”, be aware that these labels may be misleading as to the protection standards in this regard, as they do not represent the protection standards of a *vehicle system*; thus they are insufficient to provide confidence of safety to the vehicle’s occupants. Terms such as VR7 and VR9 are more meaningful in that they are BRV 2009 specified levels of protection.

In summary, independent testing of the “whole of vehicle” design, referring back to recognised international standards, is a critical element in ensuring that the CAV being procured protects against the assessed threats. Importantly, the buyer has the confidence that from a duty of care perspective, the vehicle design will live up to its “marketing reputation”.

Design Issues

To be sure, while various uparmouring manufacturers make independently verified CAVs, they all do it a bit differently. It should be said that it is the end result being a successfully protected vehicle that is important. Design differences are, in essence, the commercial advantage of each manufacturer.

Noting all that, I have found some (and definitely not all) generic design specifics that I think are very important and do make for a better vehicle design.

1. Transparent armour, i.e. glass, should be surrounded by a full window frame. In this way, the glass has significantly less potential of being pushed into or out of the vehicle in the event of a blast incident.
2. Windscreens are available with a wire mesh inserted into the sides which can then be bolted onto the A pillars. This also reduces the potential of the windscreen coming away from the vehicle in the event of a blast incident.
3. Overlaps on the door frame must be around the entire sides and top of the door and not just the area above waist height.
4. All access points in the armour steel must have ballistic covers (removable or fixed).
5. Ancillary equipment such as radio transceivers should **not** be installed exterior of the armoured steel - and while this may sound obvious and logical, many uparmourers do this.
6. The fewer the number of pieces of armoured steel welded together the better – the weld is the weakest point. For example, hot formed single

piece firewalls are advantageous.

7. Armoured steel surrounding the vehicle batteries is nice but not essential if the vehicles are fitted with AGM batteries. Remember that armour adds to vehicle weight, particularly over the front axle, which will impact mobility.
8. Round edge cut outs in doors (for installing handles, etc.) are much better than hard right angle cut outs. The reason for this is that the hard corners are a distinctly weak point when exposed to a blast.

Certainly there are many more design issues that have a significant impact on the vehicle's protection. The above are but a few examples of areas to be considered.

Summary

Well designed "whole of vehicle" protection systems that are independently verified and tested against international standards are an essential part of any best practice Civilian Armoured Vehicle.

It might sound simplistic but it needs to be said: without well designed and proven protection, a CAV is simply a very heavy and expensive car and not much use to anyone moving around a hostile environment. Even more so, it's plain dangerous and misleading to the occupants.

If I can assist you with any aspects of civilian armoured vehicles, please do not hesitate to contact me at armouredconsulting.com

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