

DuPont™  
**KEVLAR®**

# KEVLAR® TECHNOLOGY FOR ADVANCED VEHICLE ARMOURING



**To protect the occupants**, today's armoured vehicles need advanced armour systems that do not penalize the vehicle's performance. An effective vehicle armour system must be capable of providing multi-hit protection and maintaining the ballistic capability through a wide spectrum of operating conditions, such as exposure to high temperatures. Flexibility in design, ease of fitting and retrofitting, and low bulk are further essential requirements. Last, but not least, the armour systems must provide a truly cost effective solution.

**Light weight armour systems made with KEVLAR®** optimize these essential properties in advanced ballistic protection for vehicles. Designed to meet a broad range of protection requirements, these products offer the flexibility and choice necessary to accommodate varying weight, bulk and threat level constraints. Advanced armour systems using innovative KEVLAR® technologies are therefore a preferred choice for durable, weight and cost efficient protection.

# KEY ADVANTAGES FOR THE USERS OF ARMOUR SYSTEMS MADE WITH KEVLAR®

**Advanced armour panels made with KEVLAR® give professional vehicle armour manufacturers the following advantages:**

## **Ease of installation:**

The advanced composite panels made with KEVLAR® are easy to shape, and adapt to almost any vehicle body, making installation simpler, quicker and therefore less costly.

In addition, panels made with KEVLAR® are known to have better adhesion to other materials such as plastics, steel, ceramic, etc. This offers an advantage when such combinations are needed for armouring a vehicle.

## **Temperature resistance:**

Once the armour panels are installed inside a vehicle they must be capable of withstanding temperatures as low as -40° C and as high as

90° C, or even 100° C. Temperatures that can easily be reached under a hot sun and have been measured behind the metal exterior of vehicles.

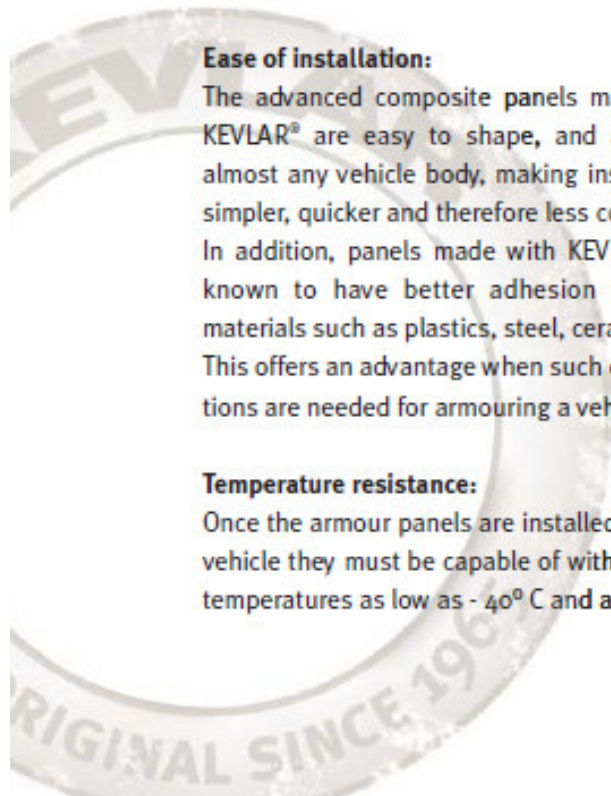
Once armour has been exposed to these temperatures it must still retain all of its ballistic performance in order to stop the threats for which it was designed. Even more critical are the armour panels next to the engine, where higher temperatures are easily possible.

It can be extremely dangerous to use armouring materials that deteriorate, that present a risk of changing, or that may even lose some of their ballistic performance when exposed to such temperatures.

KEVLAR® brand fibre offers excellent thermal stability and can be used continuously at air temperatures well above 120° C without loss of performance.

## **Fire and flame resistance:**

KEVLAR® fibres do not melt and are inherently non-flammable. In order to burn they require more oxygen than is available in the air (LOI of 28%). They are therefore used extensively in fire-fighter protective gear. They will not cause severe burns due to contact and sticking of molten polymer to the skin, and will not act as a fuel source in the case of fire. This is of particular importance in the case of over-





matching threats when ballistic armour panels can be perforated and delaminated, thus exposing the inner structure to burning material.

**Lower vehicle design constraints:**

The lighter and thinner the armour system of a vehicle, the less constraints there are to the manufacturer or to the performance of the vehicle itself.

The vehicle design, size and weight limitations are accompanied by increased use of electronics and secondary equipment. A proliferation of cables, hoses, and functional devices leaves less room for armouring panels. For certain parts of a vehicle such as the doors,

size and weight become critical in limiting the need for further structural modification of the elements themselves, or of their supporting components. In other areas further from the centre of gravity, weight will strongly affect manoeuvrability.

**Lower life cycle costs:**

The weight constraint of the armour during installation is as important a consideration as the operating life and load carrying capability of the vehicle.

In some cases, a vehicle when new may be capable of carrying the extra weight of additional heavy armour without the need to modify

the engine, drive train or suspension. However, this generally results in increased maintenance costs and greatly reduced reliability in the long run, due to the accelerated wear and tear on vehicle parts. \*

Lightweight advanced armour systems made with KEVLAR® will lower the additional weight to the vehicle, thus considerably reducing the cost over several years of operating, and will also help to extend the vehicle's useful service life. \*

*\* Inferences based on comparisons to heavier, conventional armour systems. However, statistically meaningful tests must still be carried out.*

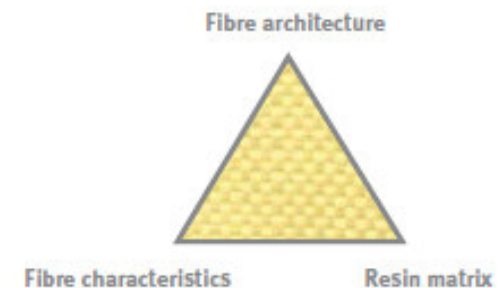
# KEY ADVANTAGES OF ARMOUR MADE WITH KEVLAR® FOR VEHICLE OWNERS

- Optimum ballistic performance versus weight, thickness and cost
- Proven performance over the temperature range reached in vehicles
- Intrinsic fire and flame resistance generally required in vehicles
- Reliability and durability of ballistic protection
- Minimum constraints to vehicle performance
- Minimum impact on the operational life of the vehicle \*
- Minimum impact on maintenance costs \*
- Improved manoeuvrability for armoured vehicles \*

\* Inferences based on comparisons to heavier, conventional armour systems. However, statistically meaningful tests must still be carried out.

The variety and increasing threat levels, such as RPG and IED, combined with the vehicle design and armour manufacturing constraints require tailored armour solutions.

The KEVLAR® Armour Design Triangle is providing the corner stone for developing an optimum, reliable and cost-efficient protection.



KEVLAR® Armour Design Triangle



Advanced armour systems of KEVLAR® for cars, air planes and helicopters provide the best combination of ballistic performance, low weight, low bulk, temperature resistance and value for money.

KEVLAR® technology brings innovative protection solutions capable of addressing a wide range of threats. Armour systems made with KEVLAR® will enhance survivability even in the presence of overmatching threats such as RPG or IED's.

KEVLAR® is there to bring the most reliable, performing, weight and cost efficient protection to those doing the hard job.



# SUMMARY

KEVLAR® advanced armour systems for automobiles, aeroplanes and helicopters provide the best combination of ballistic performance, low weight, low bulk, temperature resistance and value for money. Compared to other armour systems, they represent higher reliability in ballistic protection, longer operational life of the vehicle\*, significantly lower constraints to the vehicle performance \*, higher manoeuvrability\* and, last but not least, lower running and maintenance costs\*.

DuPont does not sell or manufacture these panels. DuPont provides the technology, systems and solutions to further improve the performance and reduce the weight of these armour panels.

\* *Inferences based on comparisons to heavier, conventional armour systems. However, statistically meaningful tests must still be carried out.*

Product safety information is available upon request.

This information corresponds to our current knowledge on the subject. It is offered solely to provide possible suggestions for your own experimentations. It is not intended, however, to substitute for any testing you may need to conduct to determine for yourself the suitability of our products for your particular purposes.

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