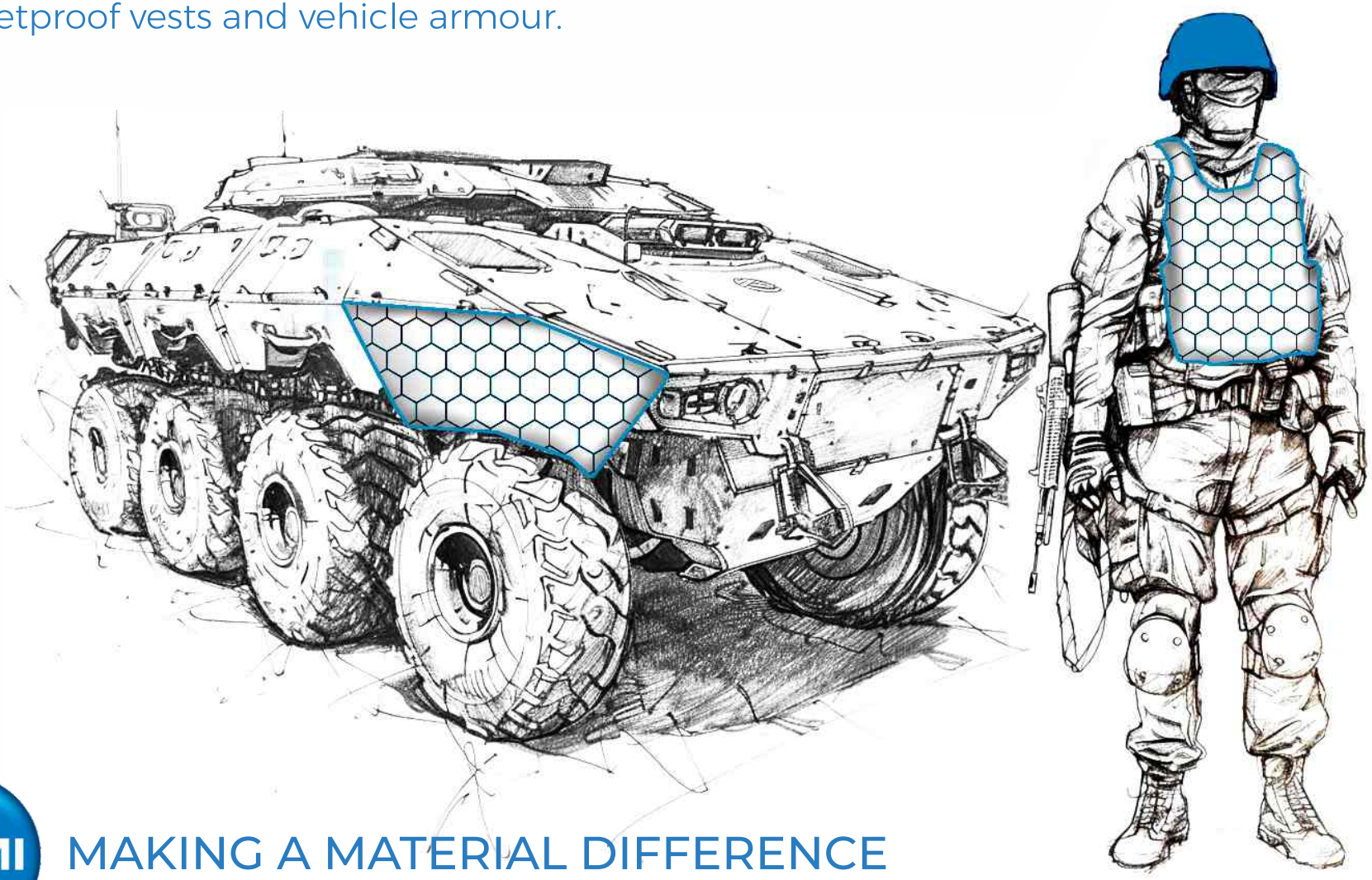
ADVANCED CERAMICS FOR PROTECTION OF MAN AND MACHINE

As a leading player in the field of materials science for over 70 years, CUMI is pioneering cutting-edge advancements in technical ceramics for bulletproof vests and vehicle armour.



CUMI MAKING A MATERIAL DIFFERENCE

Fully integrated from grain to ceramics for reliable supply

A global leader in materials science, Carborundum Universal Ltd. (CUMI) produces the raw material (grains) to engineer high-performance ceramic components designed to defend by ensuring maximum ballistic protection against evolving threats.

Our best-in-class ceramic ballistic protection range is engineered from:

- **Reaction Bonded Silicon Carbide (RbSiC)**
- **High purity Alumina (99.6% and 99.5%)**
- **Zirconia Toughened Alumina (ZTA)**
- **Reaction Bonded Silicon Carbide + Boron Carbide Rb(SiC+B_4C)**

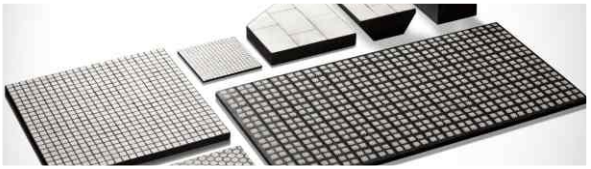
Our solutions are lightweight, ergonomic and customisable for use in bulletproof vests. Innovations in vehicle armour such as rubberised ceramic panels are designed to provide structure and dimensional stability to the ceramic tiles. This enables tailored, precise contouring of the vehicle for added protection.

Globally certified for material excellence and quality

CUMI's lightweight yet resilient solutions for personal and vehicle armour provide a much-needed alternative to conventional bulky and heavy metal armour. Our ceramic-based ballistic protection materials have been designed to meet threat levels conforming to the National Institute of Justice (NIJ) 'Level IV' and STANAG 4569 Level 3 global standards.

CUMI has also received the EN9100 (also known as AS9100D) certification for our fine powders, composites, and precision machining facilities. Our state-of-the-art manufacturing facilities have been awarded the ISO 9001 accreditation for consistently high quality standards.



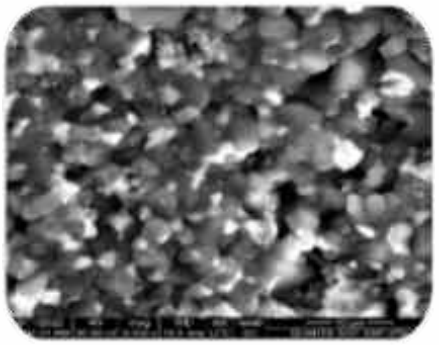




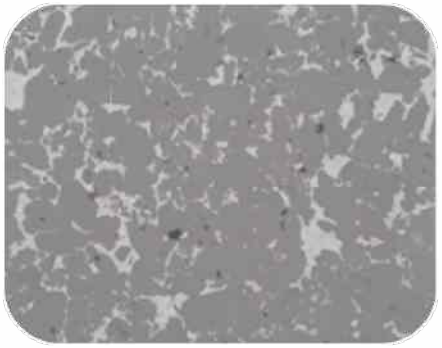

CUMI in Armour Ceramics							
Property	**Units**	**Test**	**CUMI Rb(SiC)**	**99.6% Alumina**	**CUMITUFF 995**	**CUMIULTRATUFF ZTA**	**CUMI Rb(SiC+B_4C)**
Fired Bulk Density (min)	g/cc	ASTM C373-88 (2006)	3.02	3.85	3.85	4.10	2.85
Flexural Strength	MPa	ASTM C1161-02C (2008)	320	400	370	400	250
Elastic Modulus	GPa	ASTM C1198-08	400	380	370	350	400
Poisson's Ratio	---	ASTM C1198-08	0.21	0.22	0.22	0.30	0.20
Compressive Strength	MPa	ASTM C1424-04	1800	2700	2600	2800	1450
Vickers Hardness (HV1, avg)	GPa	ASTM C1327-03	21.5	16	14.5	14.5	23.5
Fracture Toughness	$MPa.m^{1/2}$	ASTM C1421 01b (2007)	3 – 4	4 – 5	4 – 5	6 – 6.5	3 – 4
Thermal Conductivity	W/m. K	ASTM C1470-06	125	30	30	24	90
CTE	$10^{-6}/°C$	ASTM C1470-06	4.0 – 4.3	8.3	8.3	8.5	4.1 – 4.4
Sonic velocity (avg), V	Km/sec		11.5		10.6	10	11.8

*This chart is intended to illustrate typical properties of ceramic materials. The designer should recognise that exact properties may vary according to the product configuration and can sometimes be tailored to meet specific requirements. The information set forth herein should not be construed as absolute engineering data or constituting a warranty or representation for which we assume legal responsibility.

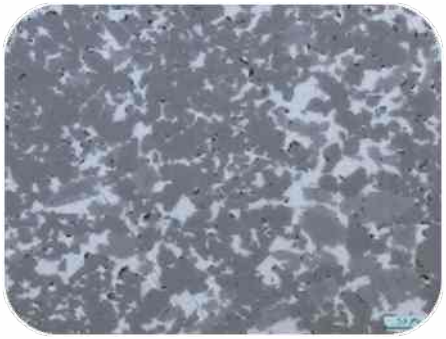
CUMITUFF 995 (99.5% Alumina)



CUMIULTRATUFF ZTA (Zirconia Toughened Alumina)



CUMI RbSiC (Reaction Bonded Silicon Carbide)



CUMI Rb(SiC+B_4C) (Reaction Bonded Silicon Carbide + Boron Carbide)

Certification from globally accredited testing agency IABG, Germany for CUMI's Composite Vehicle Armour Panels

Stanag 2

7.62 x 39 mm API BZ @695m/s ± 20 m/s
0° NATO | 22 shots | multi-hit

IABG

Accredited test institute for ballistic and blast testing of protected vehicles, protection systems, components and materials.
Akkreditiertes Prüfinstitut für Ballistik und Sprengversuche an geschützten Fahrzeugen, Schutzsystemen, Komponenten und Materialien.

C25012

Certificate
Prüfbescheinigung

Certificate (C25012)
Prüfbescheinigung

Customer: *Auftraggeber:*
Carborundum Universal Limited
47 Sipcot Industrial Estate
635 126 Hosur / INDIA

Manufacturer Ballistic Sample: *Hersteller ballistische Probe:*
Carborundum Universal Limited
47 Sipcot Industrial Estate
635 126 Hosur / INDIA

Location and Date of Test: *Ort und Datum der Prüfung:*
33165 Lichtenau (Germany),
18th February 2025

Test Specimen: *Gegenstand der Prüfung:*
Ballistic sample
Beschussmuster

Reference Designation: *Referenzbezeichnung:*
R1 (P1): R2 (P2); R3 (P3)

Respective structure of the samples:
RbSiC_rubberized_ceramics (13.5 mm)
Airgap (5.00 mm)
Ramor 550 (6.00 mm)

Test Result (summary)
Ergebnis der Prüfung (Zusammenfassung)

The above mentioned test specimen **fulfilled the requirements** according to
*Der oben genannte Prüfgegenstand **erfüllt die Anforderungen** gemäß*

Customer specification:

7.62 x 39 mm API BZ @695m/s ± 20 m/s

0° NATO | 22 shots | multi-hit

IABG Ballistic Protocol: *IABG Versuchsprotokoll:* BR25027_2

IABG Project Number: *IABG Projektnummer:* K-18759

Certificates are not valid without signature. Amendments are exclusively permitted by IABG Lichtenau. The following results only apply to the referred test and the configuration of the test specimen as described in the test report. This certificate is on valid with the following attachment.
Prüfbescheinigungen sind nur gültig mit Unterschrift. Änderungen sind ausschließlich von der IABG Lichtenau erlaubt. Die aufgeführten Ergebnisse beziehen sich nur auf den genannten Test und die im Testbericht beschriebene Konfiguration des Prüfgegenstands. Diese Prüfbescheinigung ist nur gültig mit dem folgenden Anhang.

Lichtenau, 26/03/2025

Industrieanlagen-Betriebsgesellschaft mbH – geprüft durch IABG tested by Lichtenau

i.V. Vera Caylak
Head of Department:
i.V. Vera Caylak

i.A. Dario Rosenkranz
Project Manager:
i.A. Dario Rosenkranz

IABG mbH
Test Site Lichtenau
Burghof 1
33165 Lichtenau
protection@iabg.de
iabg.de

Stanag 3

7.62 x 54R mm API B32 @854m/s ± 20 m/s
0° NATO | 22 shots | multi-hit

IABG

Accredited test institute for ballistic and blast testing of protected vehicles, protection systems, components and materials.
Akkreditiertes Prüfinstitut für Ballistik und Sprengversuche an geschützten Fahrzeugen, Schutzsystemen, Komponenten und Materialien.

C25014

Certificate
Prüfbescheinigung

Certificate (C25014)
Prüfbescheinigung

Customer: *Auftraggeber:*
Carborundum Universal Limited
47 Sipcot Industrial Estate
635 126 Hosur / INDIA

Manufacturer Ballistic Sample: *Hersteller ballistische Probe:*
Carborundum Universal Limited
47 Sipcot Industrial Estate
635 126 Hosur / INDIA

Location and Date of Test: *Ort und Datum der Prüfung:*
33165 Lichtenau (Germany),
18th February 2025

Test Specimen: *Gegenstand der Prüfung:*
Ballistic sample
Beschussmuster

Reference Designation: *Referenzbezeichnung:*
R4 (P7); R5 (P8); R6 (P9)

Respective structure of the samples:
RbSiC_rubberized_ceramics (20.5 mm)
Airgap (5.00 mm)
Ramor 550 (6.00 mm)
Airgap (5.00 mm)
Rubber-ceramic-composite (6.00 mm)

Test Result (summary)
Ergebnis der Prüfung (Zusammenfassung)

The above mentioned test specimen **fulfilled the requirements** according to
*Der oben genannte Prüfgegenstand **erfüllt die Anforderungen** gemäß*

Customer specification:

7.62 x 54R mm API B32 @854m/s ± 20 m/s

0° NATO | 22 shots | multi-hit

IABG Ballistic Protocol: *IABG Versuchsprotokoll:* BR25027_2

IABG Project Number: *IABG Projektnummer:* K-18759

Certificates are not valid without signature. Amendments are exclusively permitted by IABG Lichtenau. The following results only apply to the referred test and the configuration of the test specimen as described in the test report. This certificate is on valid with the following attachment.
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Lichtenau, 26/03/2025

Industrieanlagen-Betriebsgesellschaft mbH – geprüft durch IABG tested by Lichtenau

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Head of Department:
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Project Manager:
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IABG mbH
Test Site Lichtenau
Burghof 1
33165 Lichtenau
protection@iabg.de
iabg.de

CC30-PB-L01 Fassung 2
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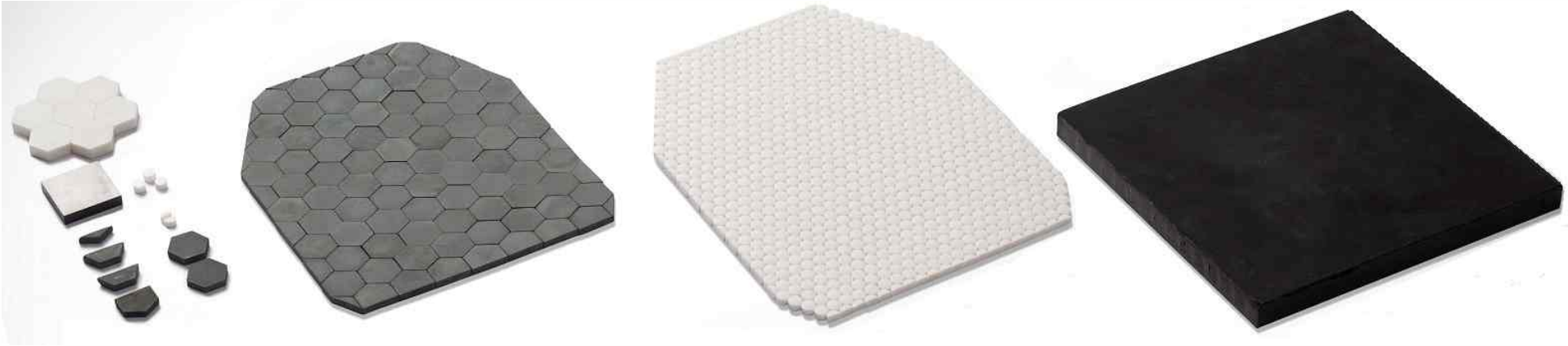

The CUMI engineering advantage for superior protection

CUMI engineers understand your unique requirement and accordingly suggest the most ideal size, shape, and configuration for superior performance and protection. Our made-to-order solutions are developed in partnership with public and private customers, qualifying agencies, and end users.

Driven by relentless innovation, technology, and research, our material solutions offer you the advantages of:

- High performance-price ratio
- Extreme toughness, durability, and reliability
- Availability in made-to-order shapes and sizes

State-of-the-art design and manufacturing capabilities

CUMI has state-of-the-art ceramic powder manufacturing and forming capabilities. We have the ability to perform firing in ambient conditions, controlled atmosphere and in vacuum furnace. We also have a wide range of accurate evaluation facilities that ensure high product reliability.

A reliable partner of choice, our competency lies in designing different grades of technical ceramics and precision lay out of armour tiles / segments. These panels can be easily integrated with suitable materials to protect against any ballistic threats.

Trusted name in materials science for over 70 years

CUMI is a trusted global leader with over 70 years of experience in materials science and engineering. We are part of the Murugappa Group which is among India's top 10 business conglomerates. CUMI has a wide global footprint and we are proud to be the supplier of choice for our customers worldwide.

CUMI's offering for Armour Ceramics			
PRODUCT	**SIZE**	**THICKNESS**	**MATERIAL GRADE**
Plain tile	50 X 50	5 to 12 mm	Alumina 99.5%, RbSiC, ZTA
Hex tile	20 A/F, 22 A/F, 30 A/F, 32 A/F	5 to 12 mm	Alumina 99.5%, RbSiC
Segments	Dia. 10mm, 12mm, 15mm, 20mm	5 to 20 mm	Alumina 99.5%, RbSiC, ZTA
Rubberised Pad	All of the above sizes	All of the above thickness levels	Alumina 99.5%, RbSiC, ZTA

CUMI CARBORUNDUM UNIVERSAL LIMITED

Carborundum Universal Limited (CUMI), established as a tripartite joint venture in 1954, is a leading materials sciences engineering solutions provider. Part of the 120-year-old Murugappa Group, it is listed on the National Stock Exchange (NSE) and Bombay Stock Exchange (BSE). CUMI is a mines to market company whose integrated operations include mining, power generation, fusion, manufacturing, marketing and distribution.

CUMI has over 5,500 employees worldwide who collaborate, innovate and develop high-quality material solutions and world-class services in abrasives, electro minerals, ceramics, refractories and energy storage materials, serving customers in diverse industries including engineering, fabrication, auto and auto components, infrastructure, steel, glass, power generation and distribution, mining, aerospace and defence. CUMI has a wide geographical presence spanning six continents and exports products to over 50 countries.

For any enquiries, you may contact us at:

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