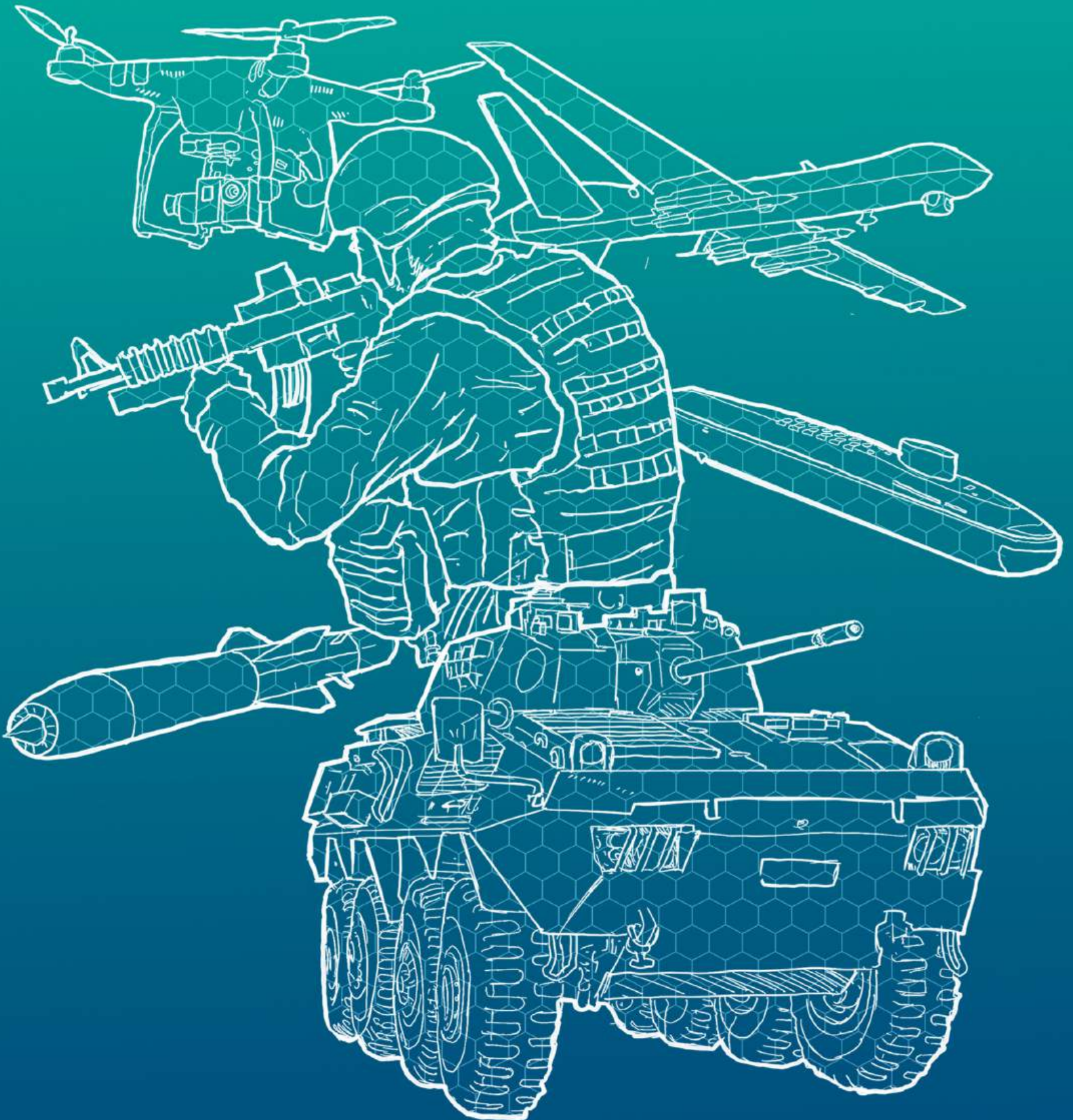




# MAKING A MATERIAL DIFFERENCE

TO AEROSPACE  
AND DEFENCE



# MAKING A MATERIAL DIFFERENCE

Carborundum Universal Limited (CUMI) is an indigenous materials company with fully integrated operations across the value chain including mining, power generation, fusion, manufacturing, marketing and distribution.



CUMI has built world class capabilities to provide solutions across Industrial Ceramics, Composites, Abrasives, Electro minerals, Super Refractories and Energy Storage Materials.



For the Aerospace and Defence industry, we are focussed on making a material difference to safety and protection for man and machine across terrains.



# PROTECTING WHAT MATTERS



## PERSONAL ARMOUR SOLUTIONS

CUMI's ceramic solutions along with an appropriate fibre backing structure makes personal armours strong and resilient.

# PERSONAL ARMOUR SOLUTIONS



CUMI manufactures ultra-fine silicon carbide sub-micron powders with high chemical purity, controlled specific surface area, high degree of chemical inertness suitable for use in engineered ceramic compounds. This ultra-fine silicon carbide powder is a vital component of CUMI's highly reliable ballistic solutions. Our contemporary solutions come as a refreshing contrast to the conventional bulky and heavy metal armours. Engineered with alumina and Silicon Carbide, CUMI's lightweight ceramic ballistic solutions are ergonomic, easy to wear and customisable into various sizes and shapes.



## The ballistic solution range uses materials including:

- High Alumina (90%, 98%, 99.5% Alumina purity)
- Reaction bonded silicon carbide
- Sintered Silicon Carbide
- Zirconia toughened Alumina

Our solutions are designed to meet threat levels conforming to international standards National Institute of Justice (NIJ) 'Level IV'.

## Solutions include :

Single Curve  
Plate

Multi Curve  
Plate

Torso  
Plate

Square/Rectangular/  
Hexagonal tiles

Cylindrical  
segments

## Applications :

Bulletproof vests

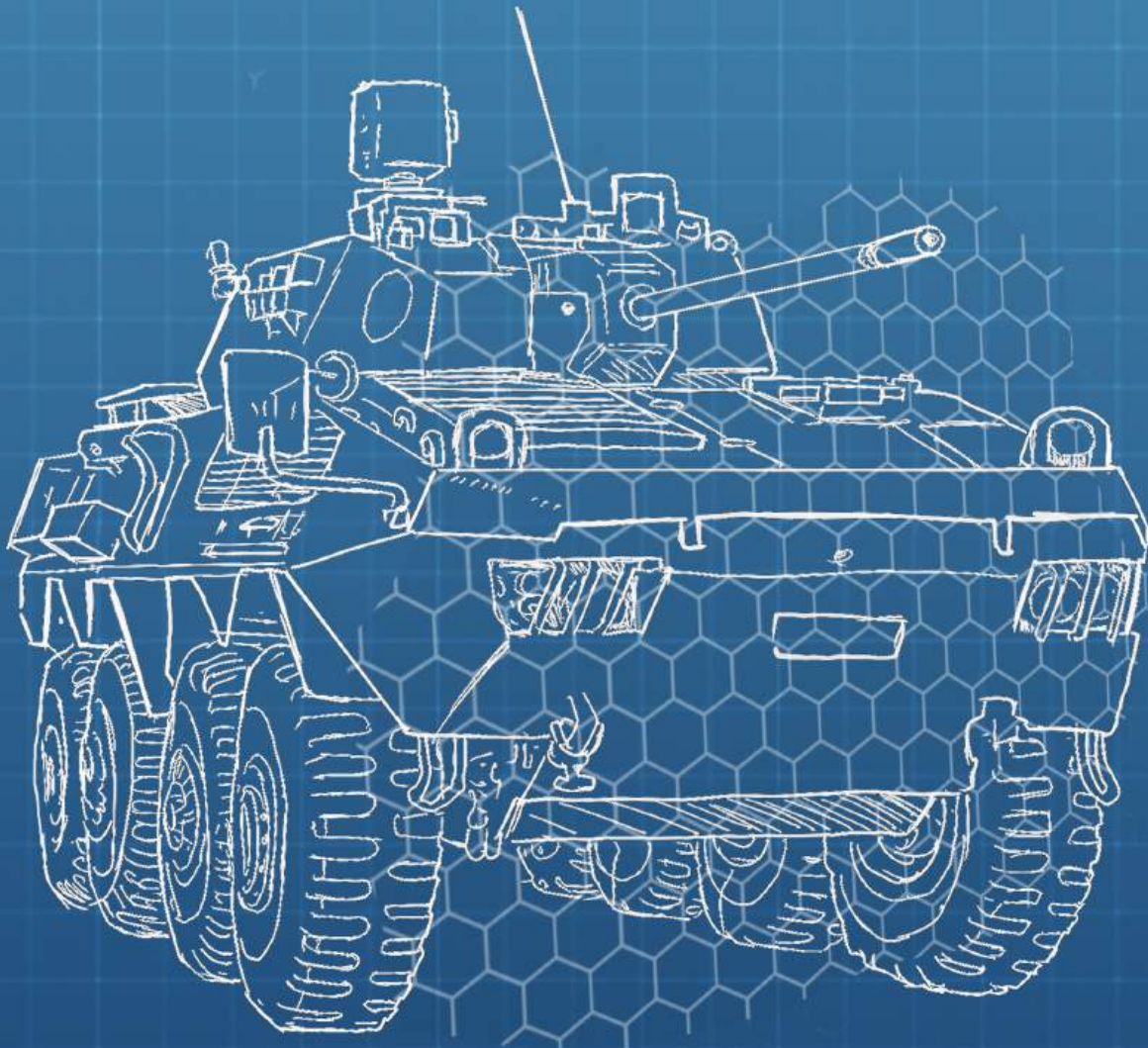
Ballistic helmet

Ballistic shields





# DESIGNED TO DEFEND



## VEHICLE ARMOUR SOLUTIONS

With over six decades of experience in engineering and our intimate knowledge of machines, enables us to create quality design solutions to fortify machines in the front line.

# ADVANCED CERAMICS FOR VEHICLE ARMOURS

Whether it is designed or co-created, our high performance lightweight ceramic materials are made for the highest levels of ballistic and blast proof protection for armoured vehicles.



Hybrid composites for blast protection of vehicle undercarriage



Ballistic protection for floor and side panels



Ceramic tiles for overall vehicular ballistic protection

Our ceramic product range for battle tanks include hatches, top deck cover, side plates and fuel tank covers.

CUMI

# STRENGTHENING THE UNMANNED



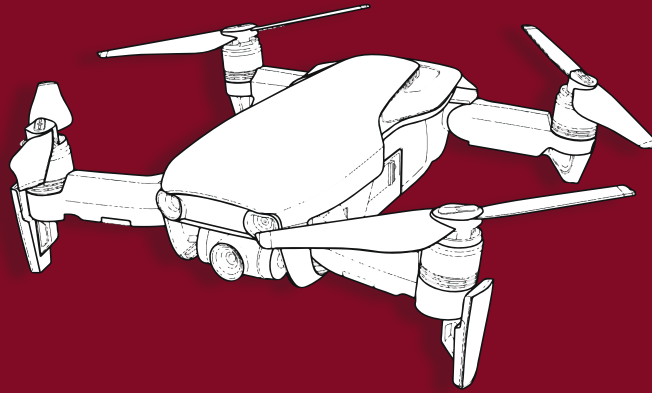
## COMPOSITES FOR UAVS

**CUMI offers light weight, high tensile strength,  
Carbon Fibre Reinforced Polymers (CFRP)  
structural parts for UAVs.**



# COMPOSITES FOR UAVS

CUMI's Composites Manufacturing Division has over five decades of experience in design, manufacturing and testing of composites. From payload holders to landing gears, CUMI brings cutting edge composite technology for UAVs. CUMI's solutions include CFRP tubes, sheets and customised composite structural parts for UAVs.

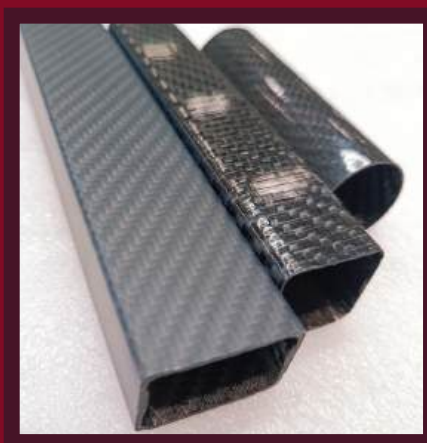


## CFRP PRODUCTS

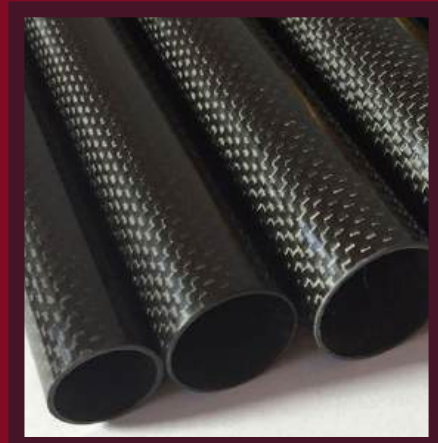
CFRP sheets



CFRP tubes



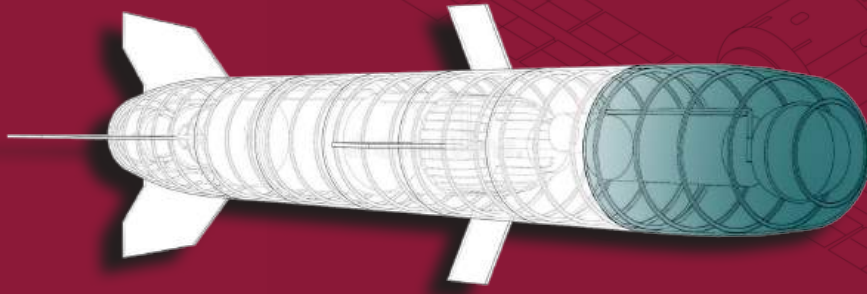
Customized CFRP structural parts



Our dedicated space for a dust-proof facility to manufacture CFRP parts for UAVs. Process capabilities of the facility include:

- Vacuum infusion & vacuum bagging
- Resin transfer Moulding (RTM)
- Pultrusion
- Filament Winding

# ADVANCED CERAMICS FOR THE AEROSPACE AND DEFENCE INDUSTRY



## CERAMICS FOR MISSILES

CUMI offers :

- structural ceramics for missile components such as radomes
- metallized ceramics for triggered spark gaps
- spare parts such as ceramic fasteners

## CERAMICS FOR CAPACITIVE SENSORS



Customised silver coated ceramic capacitors to detect even the slightest changes in process parameters

## CERAMICS FOR SATELLITES



High dielectric strength ceramics for various applications in satellites such as ceramics for battery terminals and ceramics for propulsion systems

## MICROWAVE CERAMICS



Metallized hermetic alumina ceramics for vacuum electronic devices in radar systems

## CERAMICS FOR OXYGEN SENSORS



Zirconia ceramics for oxygen sensors in aircraft cockpits (developed for LCA cockpit)

## CERAMICS FOR NIGHT VISION DEVICES



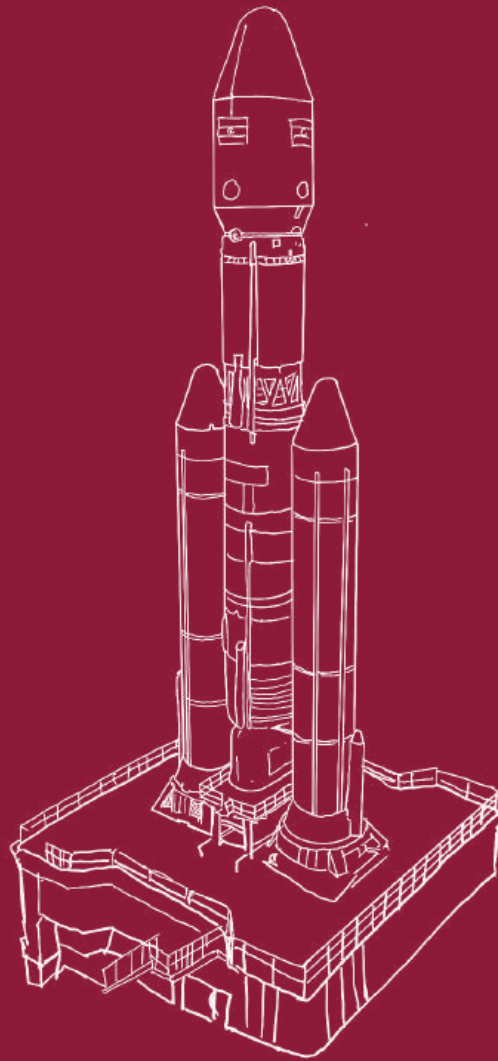
Metallized ceramic rings used in image intensifier tubes for defence applications

## CERAMIC SUBSTRATES FOR AVIONICS



Metallized alumina substrates with custom shapes and profiles for avionic applications

# REFRACTORIES



Refractories are materials that can withstand very high temperatures – over 1200°C and bear load at those temperatures without catastrophic failure. Among the oldest of the applications for ceramics, the refractory business of CUMI focuses on delivering built-to-design solutions for the ferrous, non-ferrous and chemical process industries.

CUMI's refractory products are used in investment casting of super alloys for the aircraft engine turbine blade industry. Our nitride bonded silicon carbide is used in ballistic protection. Silicon carbide thermal heat shields are also found on the underside of space re-entry vehicles to protect them from burning up on re-entry.

# GRAPHENE

Graphene, the strongest, thinnest material ever known to man stands out as a 'Wonder Material', at just one atom thick. Our scientists and engineers in the R&D division have helped develop various grades of graphene and create graphene-integrated innovative solutions to use the revolutionary potential of Graphene.



12,000 sq.ft. facility

4 MT/year of Graphene

20 MT/Year of Polymer master batches

Fully equipped Application Lab

**CUMI provides a wide range of Nano Materials such as**

**NANO CARBON POWDERS**



**POLYMER MASTER BATCHES**



**NANO CARBON PRODUCTS**



# GRAINS AND POWDERS

CUMI Minerals works on 38 different technology platforms to produce over 75 different high performance minerals across Fused & Sintered Minerals. Powered by science and innovation, our grains and grits cover the complete line of abrasive grains including shapes, sizes (as per FEPA standards) and densities.

- White fused Alumina (>99.4% Al<sub>2</sub>O<sub>3</sub>)
- Brown fused Alumina (>95% Al<sub>2</sub>O<sub>3</sub>, ~3% TiO<sub>2</sub>)
- Silicon Carbide (>98% SiC)



## THERMAL SPRAY POWDERS

Thermal Spray coatings (plasma sprays/ HVOF) protect surfaces of aircraft components and engine parts by creating thermal barriers, and by providing wear/chemical/corrosion resistance. CUMI offers high quality thermal spray powders (grit sizes and composition of powders can be customised as per customer requirements):

- Ytria Stabilised Zirconia
- Alumina
- Titania
- Alumina Titania

## GRAINS FOR ABRASIVE BLASTING

Abrasive blasting is used for surface preparation of aircraft components before PVD, thermal spraying, or electroplating. It is also used for paint stripping. CUMI manufactures the complete line of abrasive grains in various shapes, grit sizes (as per FEPA standards) and densities, etc. to perfectly fit any blasting operation and working conditions :

- White fused Alumina (>99.4% Al<sub>2</sub>O<sub>3</sub>)
- Brown fused Alumina (>95% Al<sub>2</sub>O<sub>3</sub>, ~3% TiO<sub>2</sub>)
- Silicon Carbide (>98% SiC)

## GRAINS FOR AIRCRAFT BRAKES

CUMI offers Micro Silicon Carbide grains with stringent particle size distribution possessing high toughness & hardness, excellent abrasion and wear resistance, along with physical & chemical stability at high temperatures which make it an ideal component for aircraft brake linings & pads. (Purity: >98% SiC, Size: F600 FEPA)

## GRAINS FOR THE INVESTMENT CASTING INDUSTRY

Investment casting is used for making complex-shaped components which require tighter tolerances, thinner walls and better surface finish than can be obtained with sand casting.

## GRAINS FOR MARINE ANTI SKID PAINTS

CUMI offers White Fused Alumina grain to manufacturers of marine grade anti skid paints. These paints are used as anti skid coating on the ship deck of commercial and defence marine vessels.

Grit size customisable as per customer requirements.

# ABRASIVES



CUMI has over six decades of experience engineering surfaces. Combined with our deep understanding of materials, we have been able to create a range of products and solutions exclusively for the Aerospace & Defence industry including :

## **BONDED ABRASIVES**

- Centerless Grinding of high volume Aerospace parts (fasteners, valve systems)
- Turbine blade root grinding
- Inner /Outer Diameter grinding of aerospace precision components
- Gear grinding

## **SUPER ABRASIVES**

- CNC universal surface grinding machines
- Creep feed grinding machines
- Horizontal & Vertical honing machines

## **SUPER ABRASIVES**

- Turbine blade regrinding
- Diamond dressers
- High precision aero component grinding
- Honing of gun barrels

## **COOLANTS**

CUMI offers synthetic metal working fluids designed primarily to improve productivity in demanding grinding and machining operations on hard and difficult alloy components used in the aerospace & defence industry

## **PRECISION COMPONENT MANUFACTURING**

- 5 axis grinding machine
- Double disk thickness grinding machine
- CNC Citizen twin spindle turning machine
- Honing machines
- CNC ID grinding machine
- Ultrasonic cleaning machine
- Particle analyser
- Flatness and contour checking equipment
- Form tester
- Coordinate Measuring Machine

# THERMAL CERAMICS



Murugappa Morgan Thermal Ceramics Limited (MMTCL) offers Thermal, Acoustic, and Passive Fire protection solutions. MMTCL is a joint venture between CUMI and Morgan Advanced Materials, UK

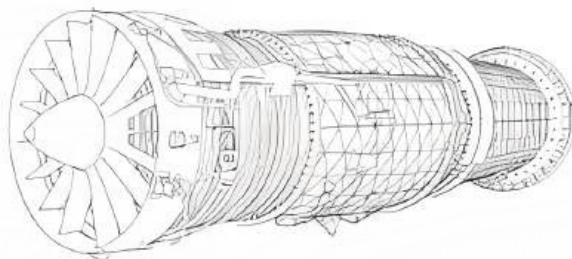
## PASSIVE FIRE PROTECTION, THERMAL AND ACOUSTIC SOLUTIONS FOR MARINE APPLICATIONS



Fire Master Marine Plus Fibre Systems which is used in marine vessels(cruise ships, warships, yachts, submarines) for passive fire protection, thermal and acoustic applications.

The application areas are bulkhead, ship decks, engine rooms, exhaust manifolds, and cabin doors.

## HEAT SHIELDS FOR AERO ENGINE COMPONENTS & FLIGHT DATA



### Challenge

Commercial and Defence aircraft require thermal insulation and fire protection for their critical components.

### Material

Min-K is a quilted microporous insulation offering extremely low thermal conductivity, high durability and high temperature (fire) survivability.

### Solutions

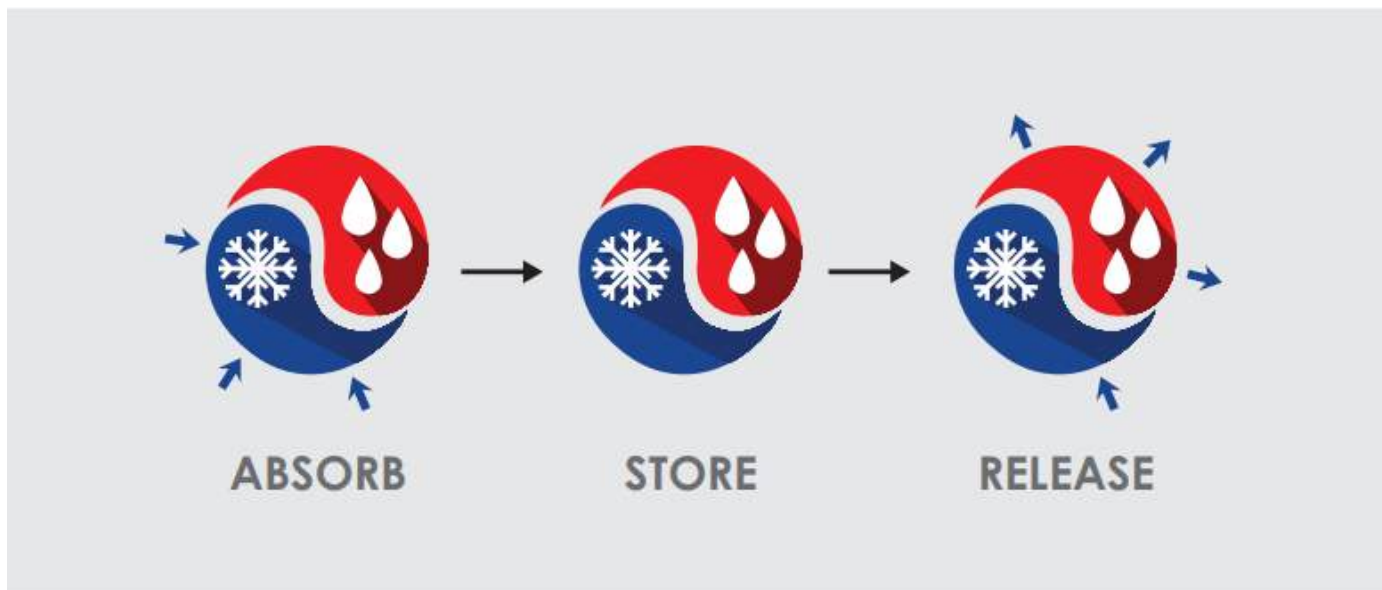
Heat shields for APU exhausts, engine nacelles, pylons, hydraulic systems, and flight data recorders.

# PLUS<sup>®</sup>

TECHNOLOGY FOR  
A BETTER WORLD

## Using savE° PCMs (Phase Change Material) for Thermal Energy Storage

Thermal Energy Storage (TES) technology eliminates the dependency on instantaneous electricity for heating or cooling applications. TES is one of the clean technologies which supports and extends the use of other clean technologies such as solar, wind, Distributed Renewable Energy (DRE), electric vehicles, etc. This means more control over the end-use without relying on electric power for the purpose of heating and cooling from the grid or electric batteries or diesel generators.



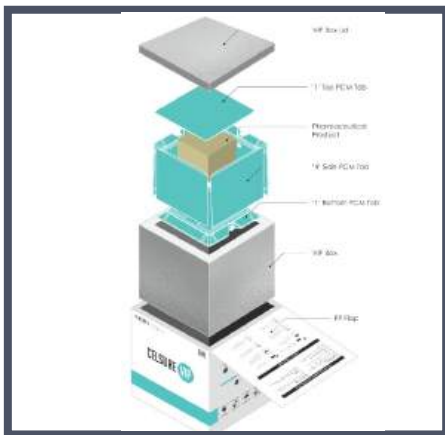
Phase Change Material (PCM) is a substance that stores large amounts of energy in form of latent heat at a constant temperature. This process is repeatable over a substantial number of cycles. In essence, a PCM can be called a thermal battery. PCMs are one of the most effective mediums of thermal energy storage as they are highly cost-effective, stable and environment friendly. PCMs have very wide scope of applications whether it is building construction, cold chain transportation/storage, solar energy storage, temperature-controlled packaging for food, pharmaceuticals, etc.





### PCM Cool jackets

The PCM Cool jackets are customisable jackets designed to provide cool comfort in any hot temperature or environment. The pockets of the jacket have four PCM pouches that contain FS-29 PCM and 2kg of PCM to provide cold comfort for up to 3 - 6 hours. The temperature difference between the body and the PCM results in heat transfer for optimal body temperatures even in the most extreme conditions.



### Celsure® - PCM - Temperature Controlled Packaging

Celsure is a range of Phase Change Material based pre-validated packaging for the temperature-sensitive products such as vaccines, clinical samples, and other saving drugs, or biologics. Celsure ensures that the vaccines that reach soldiers (Defence Sector) have travelled at safe temperatures even up to 120 hour and beyond.



### Chilled Reefer Truck

PLUSS in collaboration with FIC, Italy, offers an innovative PCM based solution for temperature controlled logistic solution to enable temperature controlled transport of food and beverages. This enables assistance in supply chain management of rations for the Indian Army.



### AAGUN® Spatial – A space heating solution

PLUSS Advanced Technologies has designed a Phase Change Materials (PCM) integrated room heating system which can provide thermal comfort in high altitude areas where temperature during night falls to as low as -20 °C. The system is designed to work independent of grid energy for 24 hours. The PCM technology enables storage of heat generated during the day using solar thermal which is used to continue heating process throughout. The system can maintain room temperature in the range of 15-25°C.

# Our Research and Development Facilities

Since 1954, CUMI's engineers and scientists have embraced challenges from various industries to create a record number of products and solutions – a legacy that inspires us even today to strive towards new frontiers in applied Material Science and Engineering. We have fully equipped state of the art R&D centres at each of our Divisions. In addition to providing top performing products and solutions, we place great emphasis on application support. Our Application Engineers analyse each customer requirement in detail and provide solutions backed by our in-house Research & Development and Testing facilities.



## Awards and Certifications



# SOLUTION RANGE

## ADVANCED CERAMICS

PERSONAL ARMOURS

VEHICLE ARMOURS

MICROWAVE CERAMICS  
CERAMIC SUBSTRATES  
FOR AVIONICS

CERAMICS FOR SATELLITES

CERAMICS FOR MISSILES

CERAMICS FOR SENSORS

CERAMICS FOR NIGHT VISION  
DEVICES

THERMAL CERAMICS

## GRAINS & POWDERS

THERMAL SPRAY POWDERS

GRAINS FOR ABRASIVE  
BLASTING

ULTRA FINE GRAINS FOR  
ARMOURS

GRAPHENE

GRAINS FOR AIRCRAFT  
BRAKES

GRAINS FOR THE INVESTMENT  
CASTING INDUSTRY

GRAINS FOR MARINE ANTI  
SKID PAINT

## ABRASIVES

BONDED ABRASIVES

SUPER ABRASIVES

GRINDING MACHINES

COOLANTS

PRECISION COMPONENT  
MANUFACTURING

## REFRACTORIES

REFRACTORIES FOR ROCKET  
LAUNCH PADS

REFRACTORY PRODUCTS  
FOR INVESTMENT CASTING OF  
SUPER ALLOYS

## COMPOSITES

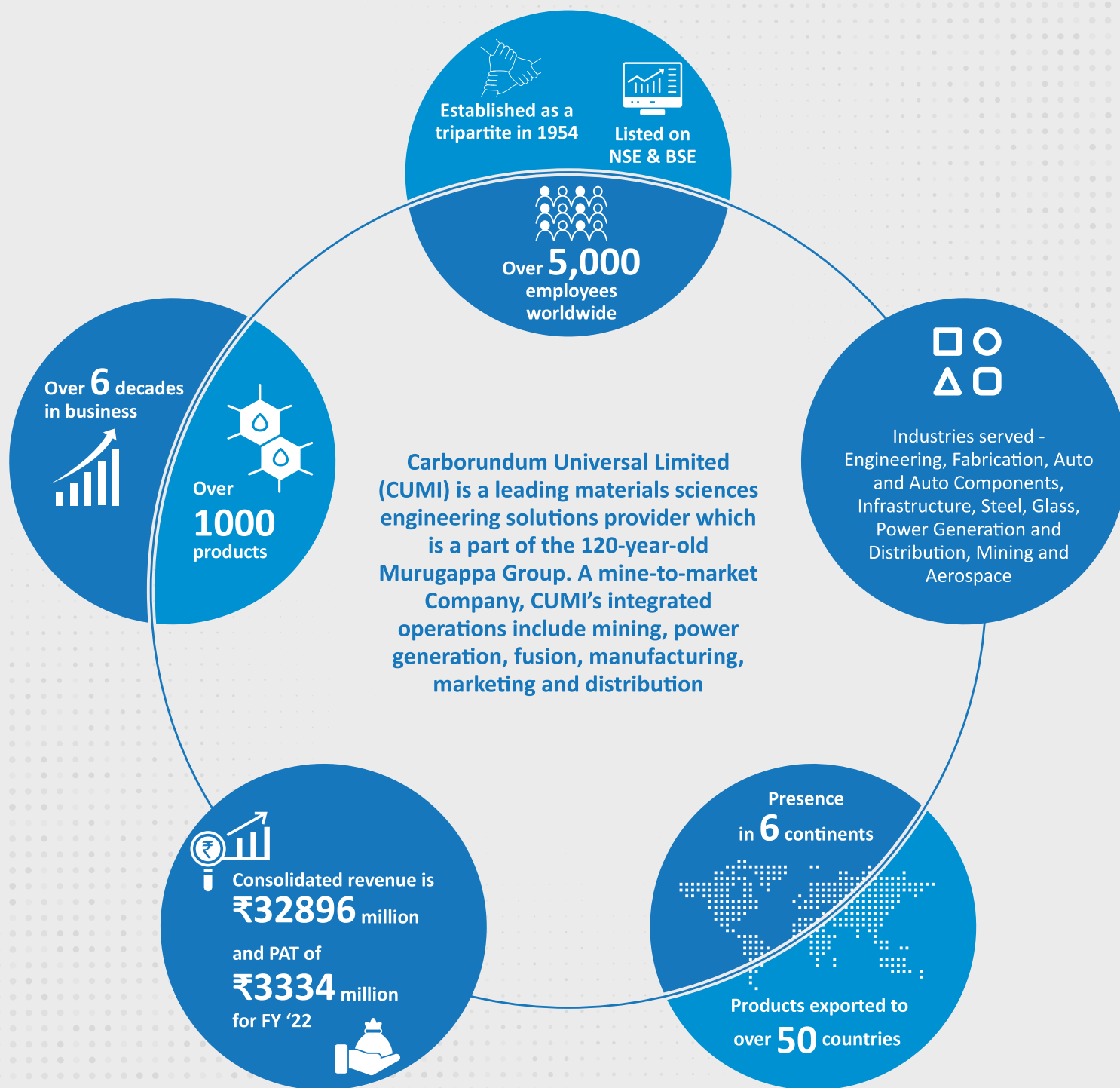
VACUUM INFUSION

FILAMENT WINDING

PULTRUSION

RESIN TRANSFER MOULDING

LIGHT RESIN TRANSFER  
MOULDING



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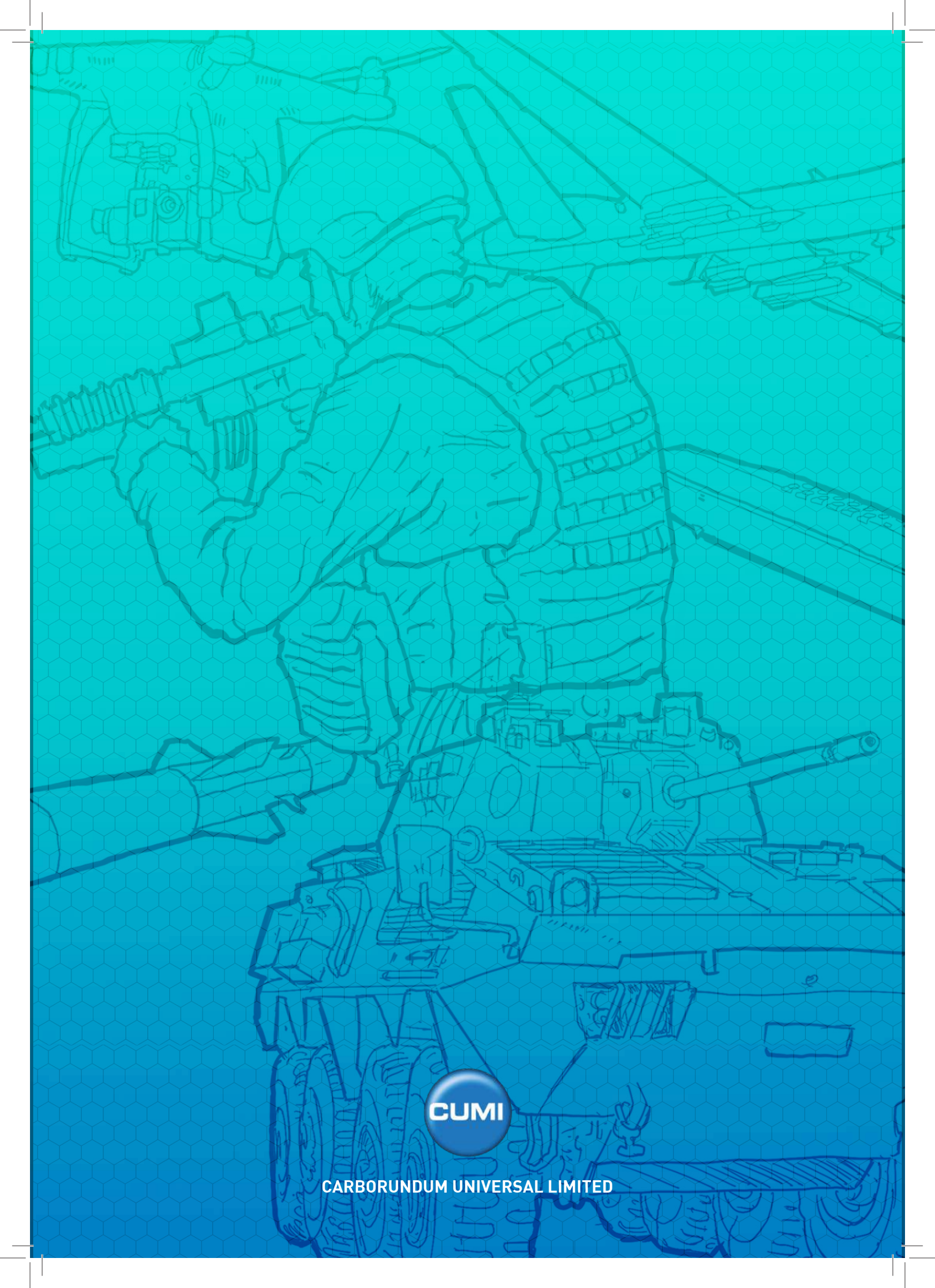
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