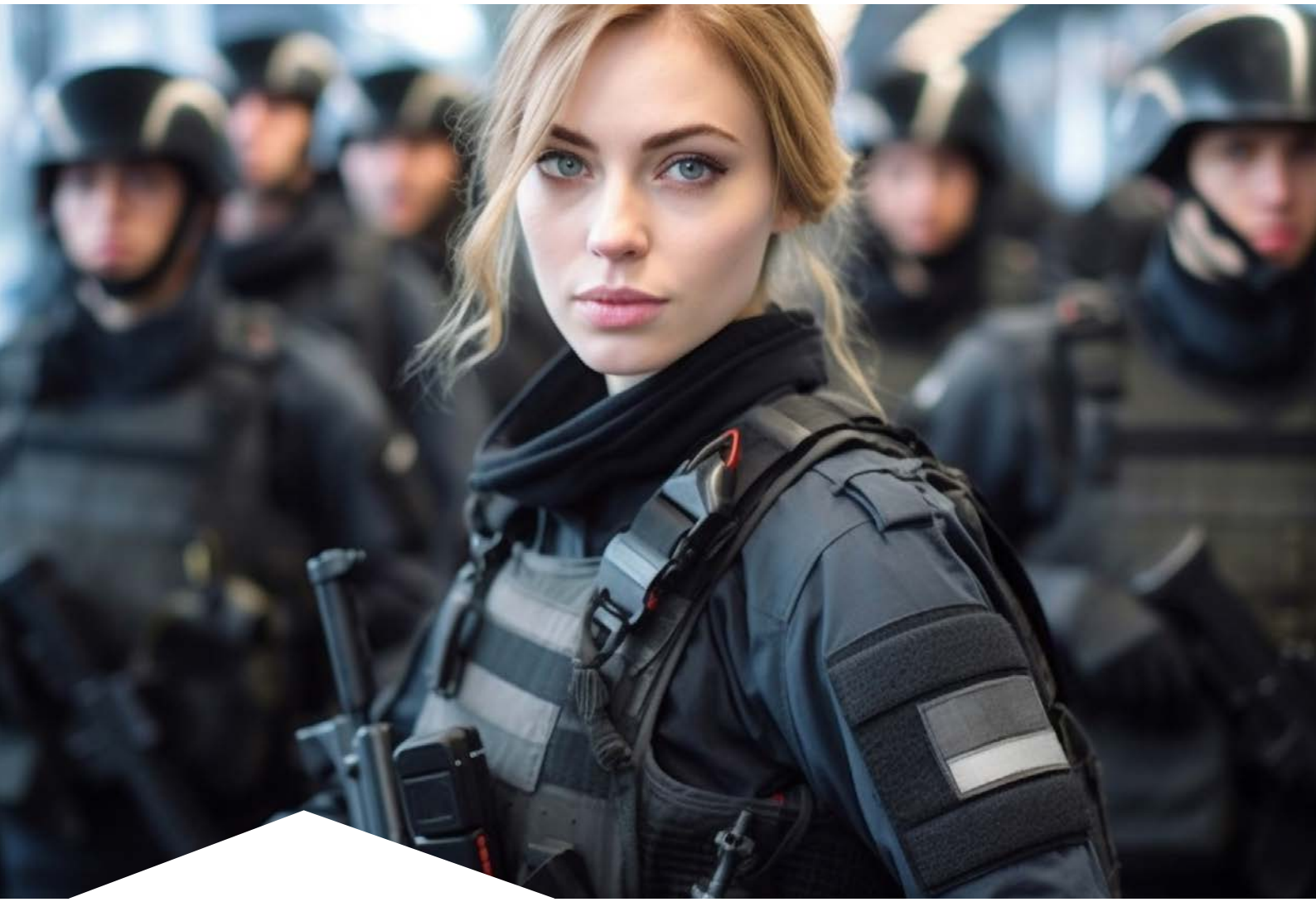
KREMPEL



# BALLISTIC COMPOSITES

## FOR THE PROTECTION OF LIFE AND TECHNOLOGY

- Military vehicles for land, water and air transport
- Protected civilian vehicles
- Personal protective equipment
- Public building and container facilities
- Machinery and equipment

# THE BEST SOLUTIONS
## FOR INDIVIDUAL CUSTOMER REQUIREMENTS

More than 30 years of experience in the composite industry with prepregs, rigid sheets and 2D/3D components with thermoset, thermoplastic or elastic matrices (rubber) have given us a deep understanding of the application of these materials in the security and defence industry.

Prepregs for these applications can be quickly coated on our systems and then pressed into sheets on our multi-layer presses or processed into components. These are used, among other things, for a wide range of ballistic protection applications.

Splinter protection applications based on all types of ballistic fibres, in combination with traditional and innovative resins, can be produced as sheets of up to 1.5 x 3 m and in autoclaves of up to 3.5 x 10 m. The production ranges from flat panels to complex 2D or 3D components.

**KREMPEL**
**ENGINEERING CONFIDENCE**

Krempel is more than just a material supplier. We support our customers at an early stage in the development of composite materials and components with our technical expertise and materials knowledge. We stand for durable and high-performance solutions in the field of ballistic protection, thus protecting life and technology.


## MATERIAL PERFORMANCE

The letters ‘M’ and ‘P’ in our logo stand for ‘Material Performance’ and reflect our commitment to working processes with the highest quality materials. It emphasises our role as a technological partner to our customers, offering comprehensive support in their product development.

Krempel has long-standing partnerships with established raw material suppliers and has been a consistent and reliable partner in the field of fibre composites for over 150 years.

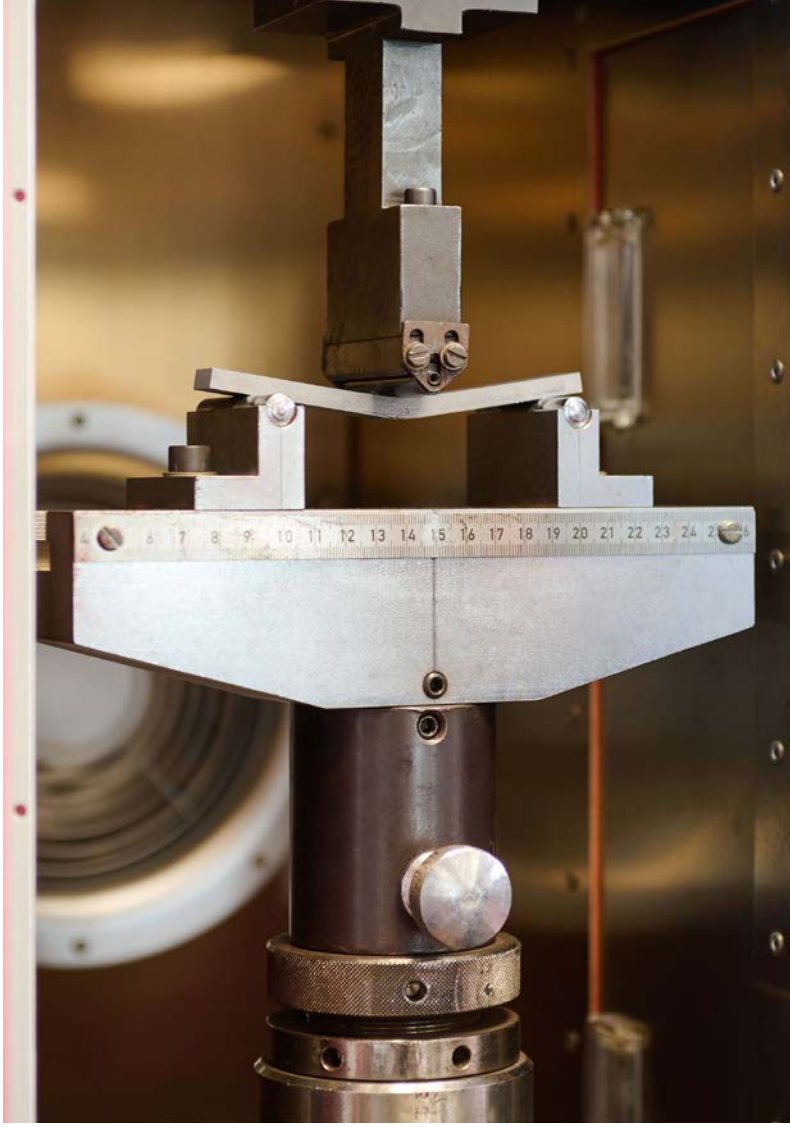
## MANUFACTURING TECHNOLOGIES

- Coating systems (up to 2 m wide)
- Presses (up to 1.5 x 3 m)
- Autoclaves (up to 3.5 x 10 m)
- Tempering ovens (up to 2.5 x 2.9 x 3.5 m)
- Secure adhesion (TLA0023 standard)
- Water jet cutting
- 3, 4, 5 & 9-axis milling
- 5 Axis router
- Injection & compression moulding
- Resin infusion & resin transfer moulding
- Convolute & filament winding
- Laminating

## SECURE ADHESION OF DEFENCE-TECHNICAL PRODUCTS

We are certified according to the TL A-0023 standard of the Federal Office for Equipment, Information Technology and Utilisation of the Bundeswehr (German Army). This standard was developed to ensure the quality of bonding in the field of defence technology.

It applies to the bonding of parts during the manufacture and repair of military products. In addition, minimum requirements for quality assurance are defined and the procedure for obtaining the operating qualification is described.



## BALLISTIC TESTS

We set the standards and place the greatest value on the reliability of our products. The ballistics tests we conduct with our partners are at the heart of these efforts and ensure that our products meet the highest standards.

**TESTING IN ACCORDANCE WITH STANAG & VPAM**

Our certified tests follow the strictest regulations and standards in accordance with Stanag and VPAM. We test our products for vehicles, helmets or vests, etc. for their performance under extreme loads by precisely simulating real conditions. The tests are carried out with the utmost precision to ensure that every component meets the requirements. We take the safety of life and technology seriously and do not allow any compromises.

Our close cooperation with manufacturers of ballistic fibres and fabrics ensures the optimal use and reliable delivery of products.

## QUALITY ASSURANCE & TEST PROCEDURES

The Krempel Group is committed to ensuring a high standard of our products, continuously developing new products and constantly expanding our expertise. All company divisions are certified according to ISO 9001. In addition, certain divisions and locations are also certified according to EN 9100 and IATF 16949.

With regard to ballistic composite materials, we carry out all the necessary tests, such as: peel tests, tensile tests or 3-point bending tests at Krempel.

Our network includes close cooperation with various testing and certification institutes. This enables us to meet individual customer requirements and to fully serve them.

# FIELDS OF APPLICATION
## FOR SOLUTIONS AND PRODUCTS FROM KREMPEL

As a leading international manufacturer of composite materials and components, Krempel contributes its expertise to protecting life and technology. Our solutions and products for ballistic protection are successfully used in the following areas, among others:

- Protected military vehicles (wheeled and tracked vehicles)
- Protective components for civilian vehicles (VIP vehicles, official and special protection vehicles, etc.)
- Protective components for aircraft (civilian and military aviation)
- Protective components for maritime vehicles (civilian and military shipping)
- Personal protective equipment (helmets, vests, protective shields, etc.)
- Protective components for machines and systems (fast-moving machine parts, machine test stands, etc.)
- Protective components for buildings and facilities (mobile field facilities, containers, government buildings, etc.)


CUSTOMS
1

## PROTECTED MILITARY VEHICLES WHEELED AND TRACKED VEHICLES

We produce top-quality components for ballistic protection in wheeled and tracked vehicles. Thanks to our many years of experience and ongoing research, we always use the most advanced materials and technologies to manufacture products that withstand extreme conditions. We flexibly adapt our products to the individual needs of our customers.

We supply semi-finished products (prepregs), plates, cut-to-size sheets and complex 3D moulded parts for these vehicles, which are made of the following materials, for example:

- E-glass roving and:
  - phenolic resin
  - modified epoxy resin
  - thermoplastic matrix
- S-glass roving and modified epoxy resin
- Aramid fabric with rubber coating
- Aramid fabric/PVB phenolic
- Aramid fabric/phenolic resin
- Customised multilayer laminates

## PROTECTIVE COMPONENTS FOR CIVIL AND VIP VEHICLES, VEHICLES FOR OFFICIAL USE AND SPECIAL PROTECTION VEHICLES

In addition to protecting military vehicles, our components are also used in civilian vehicles, where they provide excellent protection against ballistic threats. Thanks to our intensive cooperation with the relevant manufacturers of protected vehicles, we have extensive know-how in the production of ballistic protection elements.

High-quality, lightweight materials are used to ensure a high level of protection without impairing the vehicle's performance.

We supply semi-finished products (prepregs), as well as plates, cut-to-size sheets and complex 3D moulded parts, which can be made from the following materials:

- Aramid fabric with rubber coating
- Aramid fabric/PVB phenolic
- Aramid fabric/thermoplastic
- UHMWPE fibres: Dyneema, Tensylon, Endumax
- Customised multilayer laminates

## PROTECTIVE COMPONENTS FOR AIRCRAFT, CIVIL AND MILITARY AVIATION

In the field of aviation, we can not only point to successful projects in civil aviation, but also to ballistic protection elements for the defence industry.

Krempel products impress with their maximum safety, robustness, weight optimisation and reliability, as well as their compliance with international standards. This means that we meet the strict safety requirements of the aviation industry (LBA), with which we have successfully implemented the following projects:

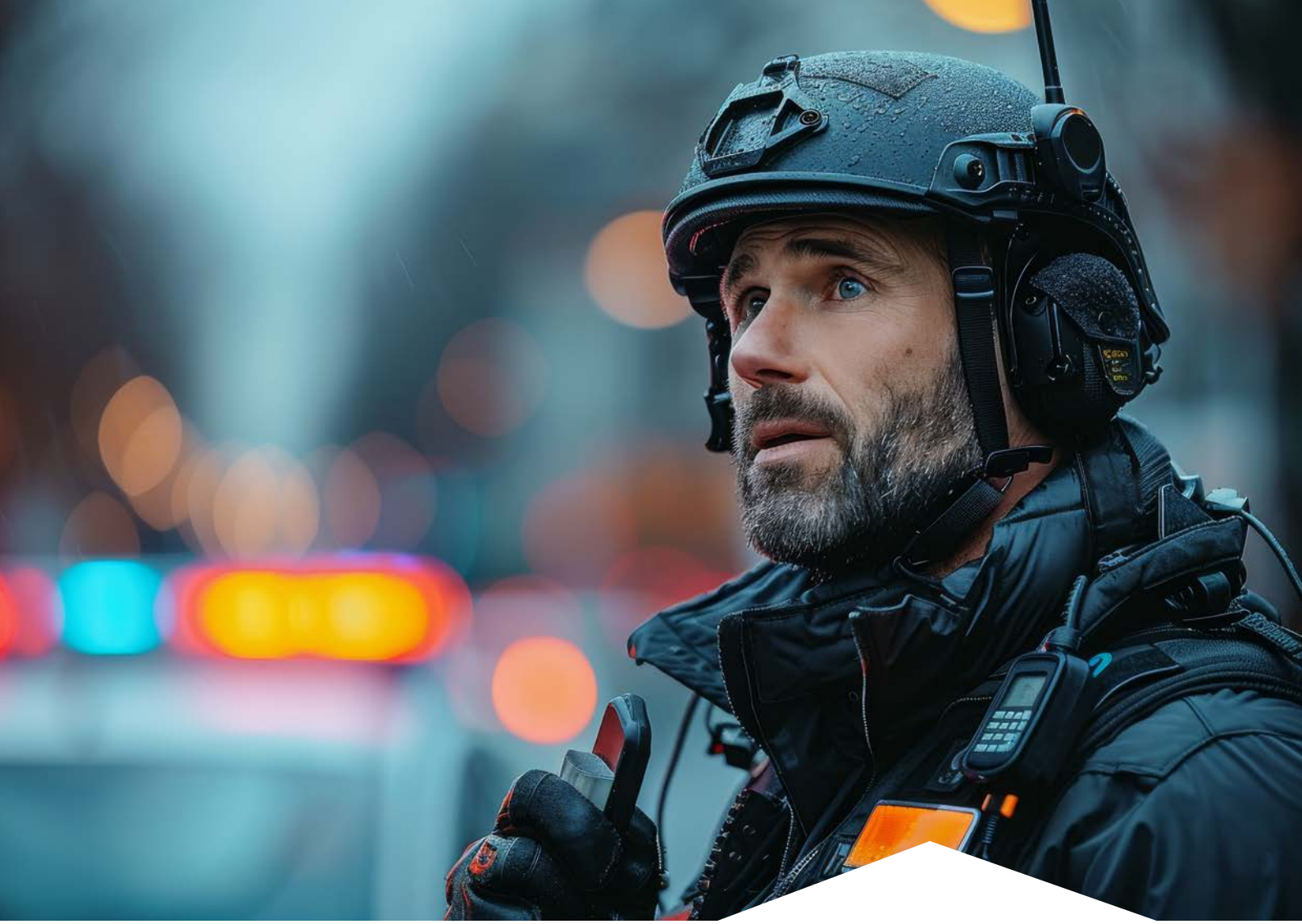
- Ballistic protection for Airbus cockpit doors and partition walls
- Ballistic protection for Airbus helicopters
- Radomes (antenna protection)

## PROTECTIVE COMPONENTS FOR MARITIME VEHICLES, CIVIL AND MILITARY SHIPPING

Radomes and other ballistic components are crucial for the protection of watercraft. They are made of durable materials such as glass-fibre reinforced plastics, which are resistant to salt water, extreme temperatures, mechanical and ballistic loads.

The manufacturing process includes the selection of suitable materials, using different techniques to form a composite part, that is then machined, assembled, primed and painted. Where applicable performance testing is also completed as part of the manufacturing process. Krempel delivers all this to you from a single source, enabling us to serve the following sectors, among others:

- Radomes (antenna protection)
- Sonar covers
- Ballistic protection for superstructures



## PERSONAL PROTECTIVE EQUIPMENT

In many security-related situations, effective personal protection is essential. Our products and solutions for protection against ballistic threats and thrust weapons are subject to the latest official standards and requirements.

Despite their high protective effect, these components offer maximum comfort. This allows the user to move flexibly and agilely, which is particularly advantageous in dynamic situations. Many of the customised solutions are used in the following protective equipment:

- Bulletproof helmets
- Bulletproof and stab-resistant vests
- Protective shields for authorities and emergency services

## PROTECTIVE COMPONENTS FOR MACHINES & SYSTEMS

In industrial environments, protective devices are crucial to protect employees, especially in the event of detached flying parts and other hazards. Krempel products also provide effective protection here and help to improve occupational safety.

The use of high-quality materials and advanced design methods ensures that the devices are robust, durable and reliable. Krempel has a proven track record in this area:

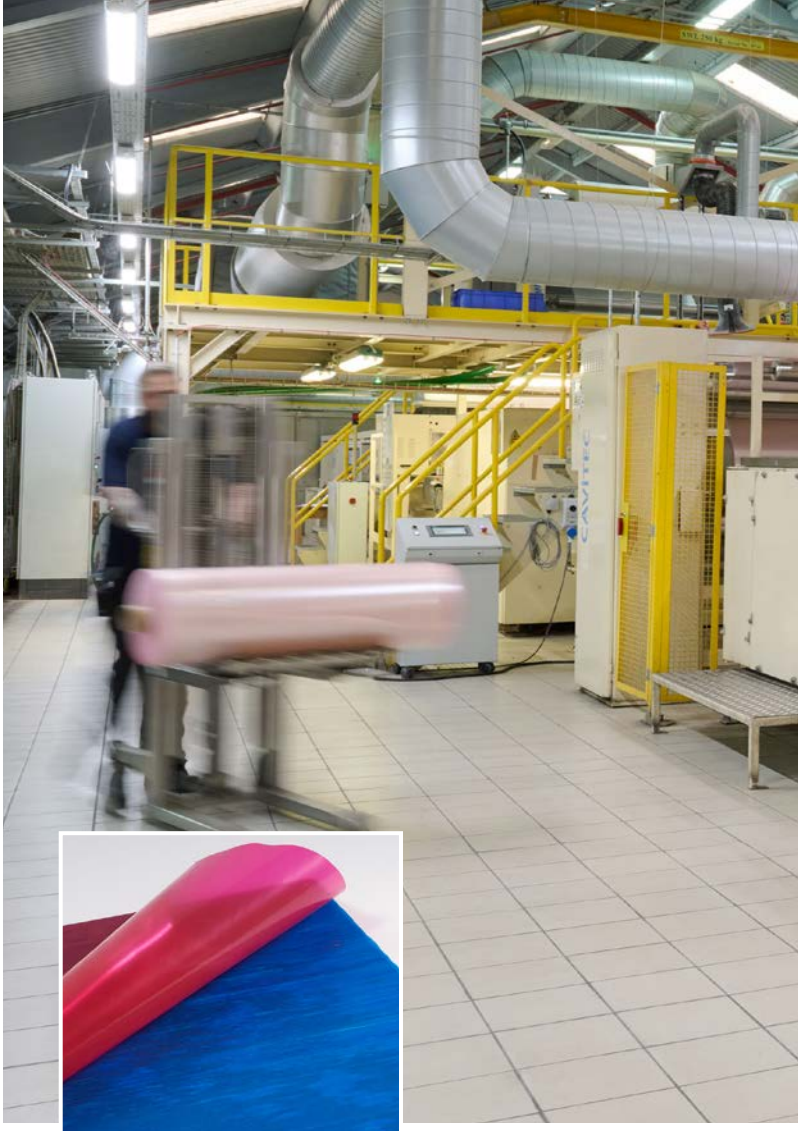
- Splinter protection cladding in mechanical engineering, e.g. machine tools, high-pressure testing devices
- Impact and collision protection, bumpers
- Heat and thermal protection for hot presses
- Low-temperature fibre composite applications

## PROTECTIVE COMPONENTS FOR BUILDINGS AND FACILITIES

In security-critical environments, such as mobile field installations, containers or government buildings, ballistic protection is essential. This ensures the safety of employees and protects important equipment.

Krempel also offers products and materials with outstanding performance and reliability in this area. Thanks to a trusting relationship with our suppliers and our own manufacturing capabilities, we can offer a fair price-performance ratio. This enables us to produce protective elements such as spall liners made of rubberised pressed aramid fabric.

# PRODUCT COMPETENCE
## IN THE FIELD OF BALLISTIC PROTECTION



## COMPOSITE MATERIALS

Composite materials and high-performance components are firmly established in the security and defence industry. They have properties and offer engineering possibilities that are not found in conventional materials.

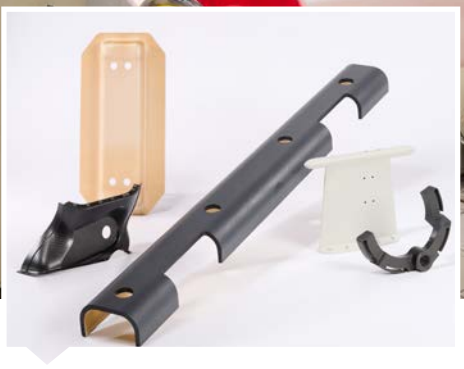
We are a leading manufacturer of fibre composite materials and support our customers comprehensively from material. Whether glass, carbon or aramid fibres, or even natural fibres, our woven and non-woven fabrics, rovings and non-crimp fabrics are impregnated with the right resin system for your product. We provide the impregnated surface material as a raw material, or pressed into plastic sheets and mouldings or plastic profiles. The production of special profiles is one of our strengths. Winding forms and laminated tubes, which are manufactured on our filament winding and convolute winding systems, are further areas of expertise.

## PREPREGS: WOVEN FABRICS & UD PREPREGS

Krempel prepregs are semi-finished fibre materials impregnated with reaction resins. Krempel manufactures prepregs based on duroplastic resin systems with all common fibre types, such as glass, carbon, basalt or aramid fibres. Natural fibres, fleeces and papers, as well as hybrid or combined structures, round off the portfolio. These diverse possibilities make Krempel prepregs the ideal basis for lightweight, high-strength construction parts in the safety and defence industry.

Krempel prepregs and UD (Uni-Directional) prepregs are based on reaction resins with a curing system that is latent at room temperature and highly reactive at elevated temperatures.

These fabrics, which can also be developed or adapted to customer-specific requirements, make us your highly specialised partner.



## PLATES

Our PREGNIT plates offer unrivalled protection against bullets and explosions in a wide range of applications, such as aircraft cockpit doors, vehicle panels and much more.

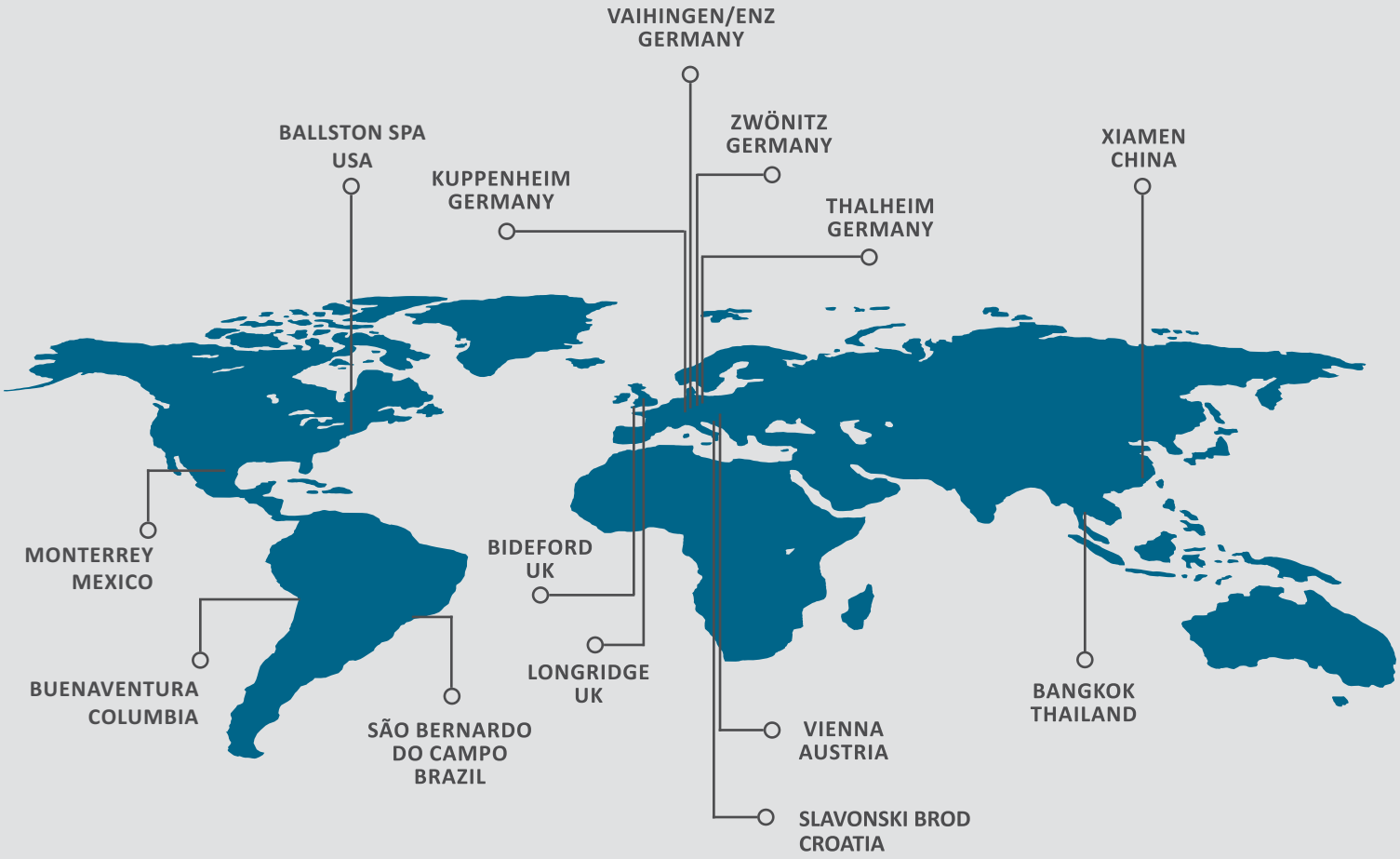
What makes PREGNIT plates so special? It is the combination of high-quality materials and innovative processing methods that make these plates a top-quality product. Thanks to our expertise in painting, laminating, grinding, drilling, milling, etc., we can deliver customised solutions that meet the specific requirements of your application. Our PREGNIT panels are not only extremely robust and durable, but also offer the highest level of security for your most valuable goods and people. Whether you are looking to protect critical infrastructure, reinforce military vehicles or increase aircraft security, PREGNIT panels will keep you safe.

## COMPONENTS

For maximum security in every situation, Krempel offers customised components. The high-quality materials we use and advanced manufacturing techniques guarantee reliable protection against ballistic threats. Our GRP/CFRP components can be manufactured in almost any 2D or 3D shape, so they fit perfectly into your existing structures.

Our dedicated team works closely with you to understand your specific requirements and develop the ideal solution.

KREMPEL




As a leading manufacturer of electrical insulation materials, composites and electronic materials, Krempel is a system partner to customers in the energy, mobility and industry sectors. Our technical materials and components help to ensure that lives and technology are protected effectively, reliably and responsibly.

The Krempel Group has 14 locations on four continents and employs more than 1.400 people worldwide.

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