

Advanced thermal
management solutions for

Aerospace Applications

Enabling **sustainability** and
safety of **people** and **processes**

> **Aerospace**

Aerospace applications

From commercial airliners to state of the art military aircraft, Morgan Advanced Materials engineer a wide range of thermal management solutions to provide exceptional capabilities whilst meeting stringent weight, temperature and performance specifications.

We can find solutions specific to your aerospace applications, whether they are commercial or defence based. The outstanding thermal properties of our products and materials provide consistent performance in extreme temperature environments from sub zero to over 1600°C (2912°F).

Our Min-K Microporous insulation systems are designed specific to the application using a combination or single solution of our Min-K Microporous and Superwool® fibres. Our aerospace applications team will work with you to engineer and supply the most appropriate thermal insulation solution for your project, anywhere around the world.

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Thermal Ceramics

We innovate to meet the challenges of a changing world



Safe and Reliable Products

Our products and systems protect lives and processes 24 hours a day and 365 days of each year.



A Truly Global Footprint

We have operations on 5 Continents and in 30 Countries to efficiently serve our Customers.



Commitment to Innovation

Our R&D and Engineering teams collaborate to create innovative market solutions that meet evolving low-carbon and technical demands.



Trusted Engineering Services

Our global resources and dynamic engineering services efficiently support our Customers application demands.

The Thermal Ceramics business of Morgan Advanced Materials makes advanced ceramic products and systems for thermal insulation in high temperature environments. We engineer products and systems for equipment in demanding applications and for the safety of people.

Our solutions help customers, especially those operating energy intensive processes, to reduce energy consumption, emissions and operating costs. Our core strength is our ability to address individual customer challenges, using our materials and our applications expertise to design, manufacture and install optimum thermal solutions.

What we do in the Aerospace industry

For more the 60 years, the aerospace industry has relied on the market leading and innovative, Min-K® Microporous insulation from Morgan Advanced Materials to provide lightweight, thermal and fire protection insulation solutions for applications ranging from Critical Data Recorders to Heat Shields for Thrust Reversers and Ducts.

These extreme environments found in aerospace applications require engineered solutions designed to meet stringent performance, temperature and weight specifications. Min-K Microporous insulation products for aerospace are chosen to fulfil applications in commercial and defence aircraft.

It is the resistance of our materials to chemical and physical wear, corrosion and extreme heat that makes them ideally suited for use in these severe-duty applications. Our solutions offer:

- Engineered solutions of rigid, flexible or panel systems.
- Low thermal conductivity, exceptional thermal efficiency, high compressive strength, low weight and low shrinkage at high temperatures.
- Dedicated teams of experienced engineers and Project Managers for a smooth execution of projects.

www.morganthermalceramics.com

[#wearemorgan](https://twitter.com/wearemorgan)

Sustainability and Reliability

are at the centre of everything we do



We realise that our clients need reliability, they need solutions that will perform and will last. In addition to the operating and technical requirements, we also recognise that our solutions have to be sustainable.



We take sustainability seriously in all aspects, from ethics and fair behaviour to health and safety compliant materials to minimisation of environmental impact.

Health & Safety is our first priority, as it is for our clients. We are continuously investing in new products that are not hazardous and that can perform in the applications that we serve.



Ethics

1. Full control of the supply chain and qualification of our vendors
2. Respect of local legislation and setting global EHS standards
3. Lining materials have a negative carbon footprint across their life cycle
4. Committed to create a great workplace for our People and be fair to them



Health & Safety

1. Creating safer workplaces for personnel and our contractors
2. Reduce health risk exposure of the personnel
3. Extensive and consistent R&D activities on new, H&S compliant lining materials and systems



Environment

1. Maximise your energy efficiency
2. Contribute to reduce your CO₂ emissions
3. Committed to continuous reduction of waste, water, energy and emissions intensity in our facilities
4. Providing heat containment solutions for the electrification process

Our thermal efficiency and CO₂ calculator

Morgan has developed a Thermal Efficiency and CO₂ Emissions Calculator (TECE) for this purpose. It provides a simplified total client's cost comparison of various lining solutions, considering Materials and Installation Price, Insulation Efficiency, Heat Storage and Cost of Energy and CO₂ Emissions over the expected lifecycle of the lining system, estimating the 'Total True Cost' over the entire Service Life and enables a 'Payback Period' to be calculated for each lining solution.

For more than 60 years, the Aerospace industry has relied on the lightweight material solutions, Min-K® Microporous and Superwool® fibre insulation from Morgan Advanced Materials to provide thermal, acoustic and fire protection insulation solutions for applications ranging from critical data recorders to heat shields and ducts.



Ultimate Aerospace Solutions

improving the safety, reliability and performance of aircraft engines and systems in extreme environments

It is by combining the exceptional capability with low weight and excellent thermal resistance that we are able to offer high performance aerospace solutions tailored to your needs.

- **Application solutions** - through a unique approach to development and manufacturing.
- **Integrated approach** - incorporating material design and manufacture.

Our Min-K® materials are AS 9100 certified and our manufacturing locations hold ISO 9001 and ISO 14001 certifications.

The pioneer of aerospace material solutions, Min-K, is an AS 9100 certified material. Aerospace engineers from the market leaders in commercial and military applications rely on Morgan to partner and develop the next generation solution in aerospace technology design.

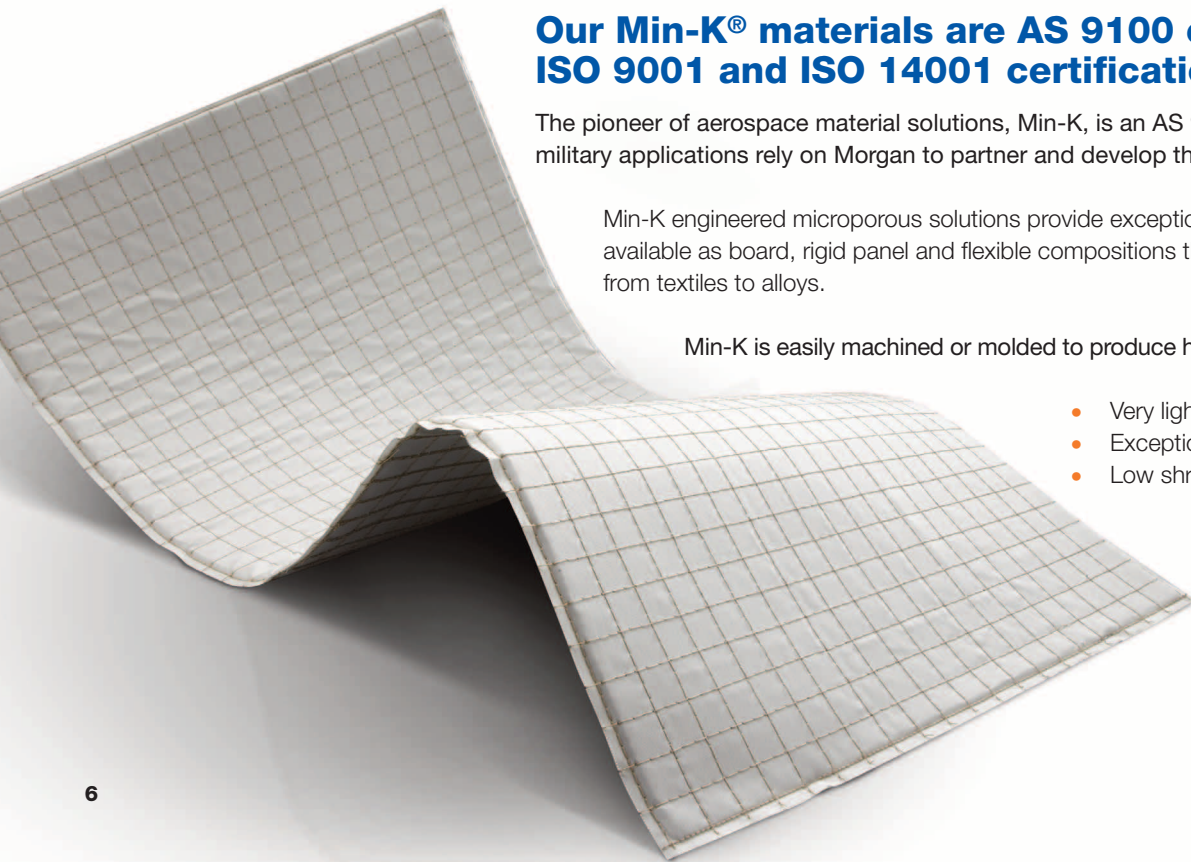
Min-K engineered microporous solutions provide exceptional thermal insulating and fire protection properties. These microporous products are available as board, rigid panel and flexible compositions that are capable of being machined or fabricated with various and facing encapsulations from textiles to alloys.

Min-K is easily machined or molded to produce high performance solutions for the most challenging applications and awkward spaces.

- Very lightweight with high compressive strength and good resistance to vibration
- Exceptional thermal efficiency
- Low shrinkage at high temperatures

Min-K is ideal for demanding thermal management aerospace applications where weight is a critical factor, such as:

- Auxillary Power Units
- Flight or Critical Data Recorders
- Bleed Air and De-icing Ducts



Superior thermal management solutions for **Aerospace applications**

Ducting Systems

From de-icing and ECS systems to engine air ducting to high temperature tubing and piping, Min-K® Flexible Microporous is encapsulated to ensure thermal management of the system process.

Auxiliary Power Unit

Min-K encapsulated solutions are proven reliable and efficient for fire protection and thermal management of auxiliary power units.

Nacelles and Thrust Reversers

Requires a solution where high temperature, high vibration environments can achieve space and weight limitations. Min-K Flexible Microporous is the solution.

Galley Ovens

Superwool® Plus blanket is the chosen insulation solution for linings oven chambers.

Flight / Critical Data Recorders

Min-K Molded and Machined insulation safeguards electronics found in Voice and Cockpit Data Recorders.

Pylon Heat Shield

Min-K Microporous and Superwool fibre insulations can be encapsulated and used in high temperature and fire protection Heat Shielding.

Hydraulics

Micro-Foil and Flexible Min-K Tapes can be used in hard to insulate areas where weight and temperature are critical. Some of the more widely used applications include fuel, oil and hydraulic lines along with high temperature tubing and piping systems.

Battery Storage

EST Superwool fibres developed and tested for thermal runaway and fire protection.

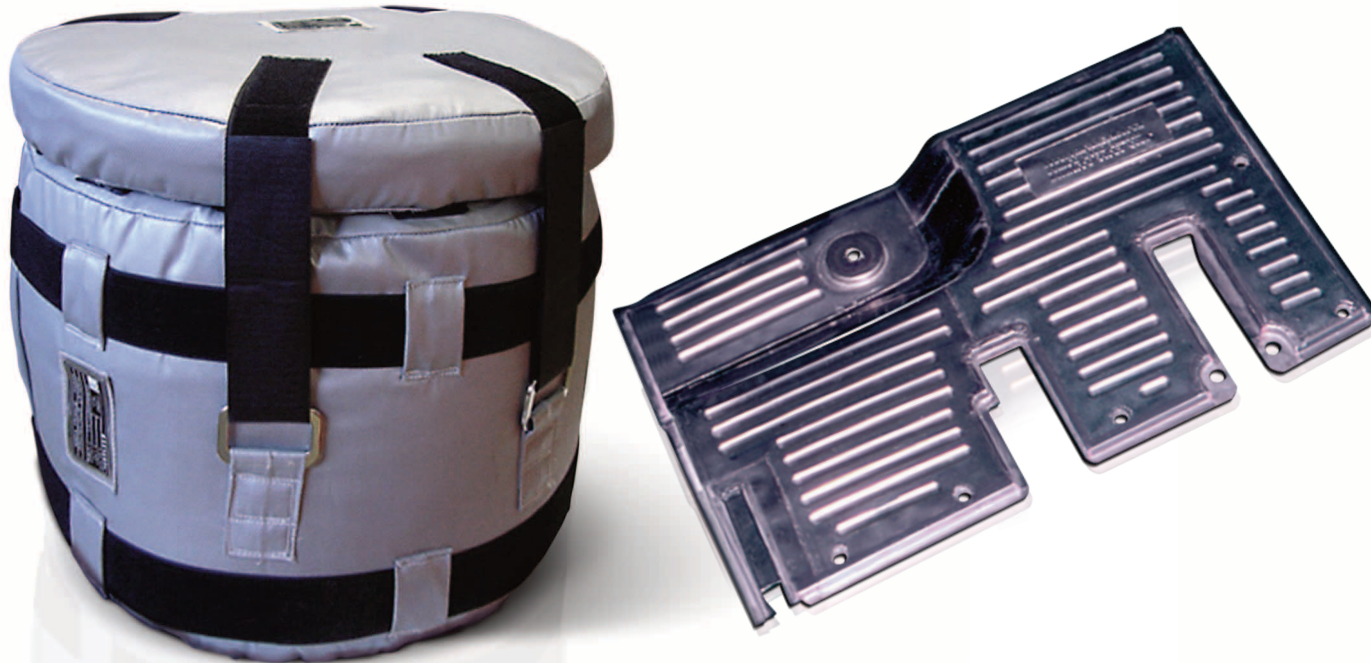
Protecting Critical Components

flight data recorders, nacelles and thrust reversers, heat shields

Weight matters. The lightest, thinnest and most thermally efficient material, Min-K[®] Microporous, has been selected for decades by aerospace market leaders in commercial and defense designs.

Our custom engineered solutions for commercial and defense aerospace applications begins with Min-K Microporous insulation. The market leading and industry proven product solution, has been specified for decades as the material choice for heat shields and critical data recorders across the aviation industry.

- Min-K Microporous Flexible is encapsulated in textile and quilted for heat shield applications
- Critical Data Recorders call for Min-K Microporous Molded into specific geometries
- Min-K Microporous Rigid is encapsulated in molded metal and seam/spot welded
- APU Exhaust, Bleed Air or De-Icing ducting is wrapped in encapsulated Min-K Microporous insulation to keep air hot and protect aircraft components



Flight Data Recorders

Min-K Microporous Molded insulation meet the harsh fire protection requirements and safeguard electronics in catastrophic environments.

Min-K Microporous Molded includes an endothermic component to extend the time required for heat to reach sensitive internals of Data Recorders in the event of a fire.



Nacelles and thrust reversers

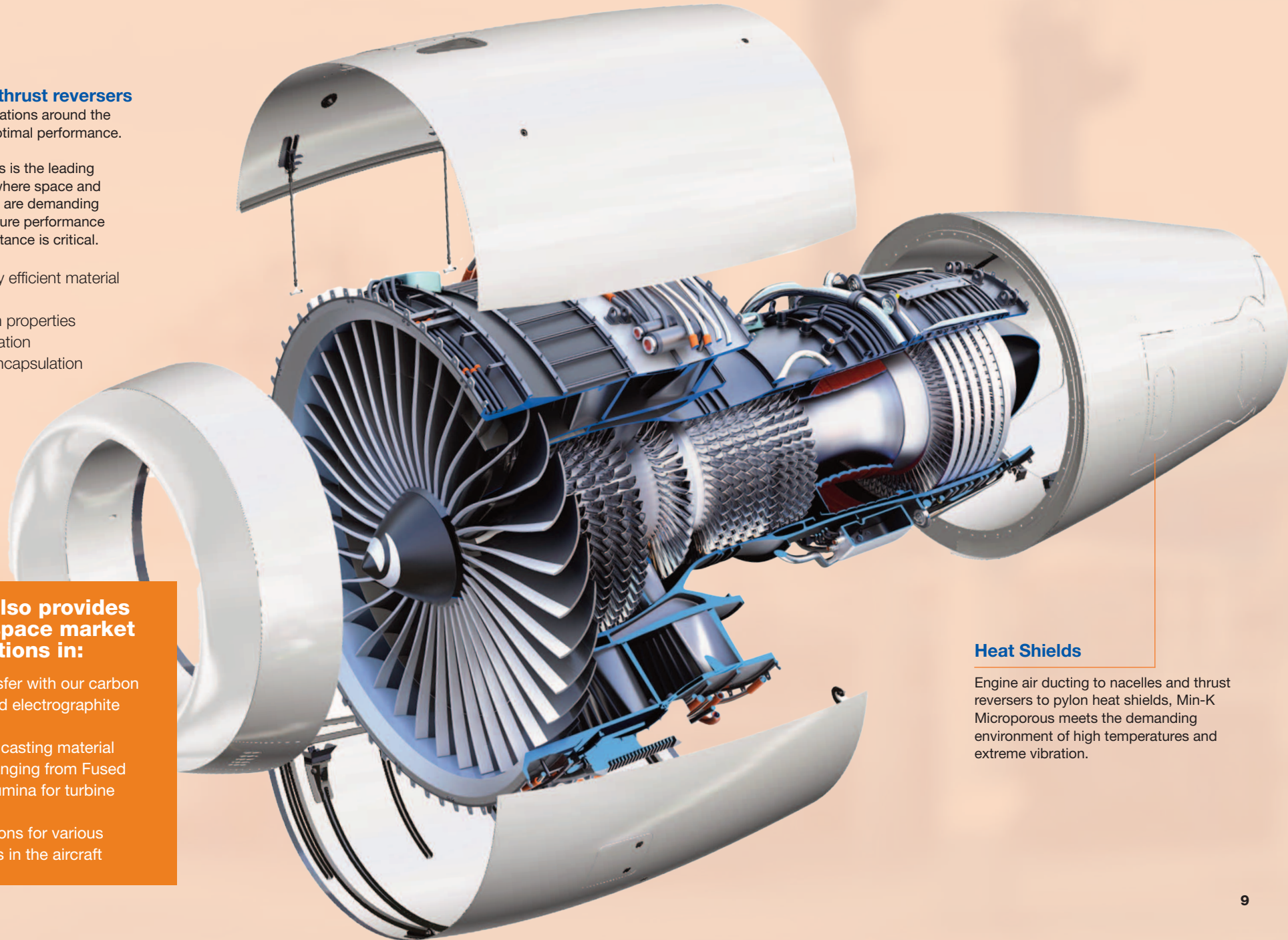
Heat Shield applications around the engine demand optimal performance.

Min-K Microporous is the leading material solution where space and weight constraints are demanding and high temperature performance and vibration resistance is critical.

- Most thermally efficient material in the industry
- Fire protection properties
- Ease of fabrication
- Heat Shield encapsulation

Morgan also provides the aerospace market with solutions in:

- Power transfer with our carbon graphite and electrographite materials
- Investment casting material solutions ranging from Fused Silica to Alumina for turbine blades
- MRO solutions for various applications in the aircraft



Heat Shields

Engine air ducting to nacelles and thrust reversers to pylon heat shields, Min-K Microporous meets the demanding environment of high temperatures and extreme vibration.

Partnering with us

We are the partner of choice for the aerospace and transport sectors. Working with us, customers are able to push the boundaries of performance without compromising safety, heat or weight management.

Our custom solutions are developed using our patented Superwool® Fibre, WDS® Microporous materials, JM-K-TJM IFBs and FireMaster® products.

These technologies help designers achieve optimal thermal management and passive fire protection, throughout petrochemical and refinery installations.



Thermal Ceramics offers products and engineered systems for high-performance fire protection applications in a wide variety of industries world-wide

Benefits of partnering with Morgan

Harnessing our world-class design expertise and specialist manufacturing capabilities, we work in partnership with some of the world's largest aerospace suppliers, developing competitive tailored solutions to meet the increasingly challenging demands of the sector. We are the forefront of technology helping manufacturers improve safety, performance, energy efficiency.

- **Research and development**
A dedicated team focused on innovating within the aerospace industry, developing superior materials which excel in real-world applications.
- **Global manufacturing**
Operations on five continents, where we collaborate with customers and deliver solutions in region to support the 'just in time' manufacturing model.
- **Supporting the reduction of carbon dioxide**
Innovative solutions, designed and engineered to drive a reduction in emissions.

Our expanding clean energy solutions

Our new ceramic materials for customers producing solar panels support the latest generation of production technology. In addition we are developing brushes that provide longer lifetimes and higher current carrying capability to support the next generation of wind turbines.

We support the EV market with alumina seals and bearings for cooling pumps which are produced to fine dimensional tolerance, improving efficiency and minimising pump noise. Our thermal insulation Superwool® is used in heat recovery steam generators, fuel cells, and energy storage walls to improve energy efficiency.



Together, we are working to reduce our environmental impact...

...together, we are working to deliver robust environmental, social & governance (ESG) practices, and together, we have defined **five** environmental, social, and governance (ESG) improvement objectives and targets to improve our performance as a Group:

Reduce our environmental impact



- 1** Our aspiration is to be a CO₂ net zero business by 2050. Our 2030 target is to reduce our scope 1 and scope 2 CO₂ emissions by 50% (from a 2015 baseline). We will start to measure scope 3 emissions from 2023 onwards, with coverage increasing over time.
- 2** Our aspiration is to use water sustainably across our business. Our 2030 target is to reduce our overall water usage by 30% and reduce our water usage in high stress areas by 30% (from a 2015 baseline).



Improve our safety performance

- 3** Our aspiration is to create an environment and culture with zero harm to our employees. Our 2030 target is a lost time accident rate below 0.1 (lost time accidents per 100,000 hours worked).



Improve the diversity and inclusion of our business

- 4** Our aspiration is that our employee demographics reflect the communities that we operate in. Our 2030 target is for 40% female representation across our leadership population of our organisation.
- 5** Our aspiration is a welcoming and inclusive environment where our employees can grow and thrive. Our 2030 target is to attain a top quartile employee engagement score.

For more information please visit: www.morganthermalceramics.com/sustainability-responsibility

#wearemorgan

Morgan Advanced Materials

Significant trends shape our modern world, accelerating the demand for new and more sustainable advanced materials.

At Morgan Advanced Materials, we use advanced carbon and ceramics materials to support the move to a more sustainable world. Our people are driven to solve complex customer problems: from managing heat and enabling greener technologies, to supporting improved medical diagnostics and protecting life.

Our Purpose

Our purpose is 'to use advanced materials to make the world more sustainable, and to improve the quality of life'. This purpose is underpinned by our safe, ethical and inclusive culture, embraced by our 7,800 employees spanning over 25 countries. Working across many industries and in a number of markets, we deliver the materials science and technologies the world needs now.

Our Strategy

We are a global advanced manufacturing organisation with leading capabilities in three areas: materials science, application engineering and customer focus.

Our Business Model

We operate as two global divisions and five global business units. We empower our global business unit teams, giving them considerable autonomy and enabling them to act quickly and support their customer needs. Our broad manufacturing footprint enables us to supply customers locally from a short supply chain.

www.morganthermalceramics.com
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