Advanced Solutions for the Aerospace Industry

Our manufacturing sites are ISO 9001 certified. The group also contains a AS9100 certified facility.

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Morgan Advanced Materials

Morgan Advanced Materials is a global materials engineering company which designs and manufactures a wide range of high specification products with extraordinary properties, across multiple sectors and geographies.

From an extensive range of advanced materials we produce components, assemblies and systems that deliver significantly enhanced performance for our customers’ products and processes. Our engineered solutions are produced to very high tolerances and many are designed for use in extreme environments.

The Company thrives on breakthrough innovation. Our materials scientists and applications engineers work in close collaboration with customers to create outstanding, highly differentiated products that perform more efficiently, more reliably and for longer.

Morgan Advanced Materials has a global presence with more than 10,000 employees across 50 countries serving specialist markets in the energy, transport, healthcare, electronics, security and defence, petrochemical and industrial sectors. It is listed on the London Stock Exchange in the engineering sector (ticker MGA.M).

We have over 60 years experience of working in the global aerospace industry. Our materials and engineering expertise combined with our manufacturing capabilities enable us to produce a wide range of innovative solutions from small batches to high volume production.

Key benefits

- Proven technologies in demanding aerospace applications
- Investors in advanced materials innovation - helping you get the best materials
- Broad array of products - enabling us to deliver optimised solutions
- Expert application engineering support
- Global footprint - providing you with support locally, when you need it

Improving the safety, reliability and performance of aircraft engines and systems in extreme environments
Our materials

The Aerospace industry demands the very best in material quality and properties, detailed below are just some of the common requirements of the industry and the materials we work with to overcome the challenges faced.

**Low Friction and High wear resistance**
- Alumina
- Carbons
- Graphites
- Silicon Nitride
- Diamond Like Carbon (DLC) coatings

**High temperature and thermal shock stability**
- Silicon Nitride
- Aluminium Silicate
- Piezoelectric Ceramics
- Carbon
- Graphite
- Precious Metal Braze Alloys
- Melt Spun Foils

**Dimensional stability across broad temperature range**
- Fused Silica / Zirconia
- Aluminium Silicate
- Silicon Nitride
- Aluminium Silicate
- Piezoelectric Ceramics
- Carbon
- Graphite

**Low outgassing under high vacuum conditions**
- Aluminium Silicate
- Alumina
- Carbon / Graphites

**Thermal Management and Fire Protection**
- Min-K® Microporous insulation
- Kaowool® insulation fibres
- Carbon / Graphite fabric insulation
- Carbon / Graphite felt insulations
- Alumina
- Superwool® low bio-persistent insulating fibre

**Electrical Insulation across broad temperature range up through high voltages**
- Aluminium
- Zirconia

**Broad Chemical Compatibility**
- Aluminium
- Zirconia
- DLC Coatings
- Carbon / Graphites
**Thermal management**

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.

**Carbon felt**

Morgan manufactures rayon based carbon and graphite felt and rigid insulation for vacuum or atmospherically controlled furnaces. Our felts are processed to the highest temperatures in the industry. Ensuring high purity, dimensional stability and no off gassing along with excellent thermal conductive properties. Our materials can be coated or foil faced to provide additional protection and extend overall life.

**Thermal heat shields**

Thin, light weight and exhibiting excellent thermal resistance, the stainless steel and titanium encapsulated heat shields produced by Morgan are ideal in aerospace applications. Key products include our lightweight Shell Technology, designed to follow the shape of your equipment. Integrated Technology for the insulation of large or complex equipment and Flexible Technology, an easy to fit and to remove solution providing effective heat shield protection up to 950°C.

**High temperature insulating papers**

Our low-low-persistent Superwool® paper and Kaowool® ceramic fibre paper are produced from bulk fibres or engineered fibre blends in a wet-laid process. The state-of-the-art paper manufacturing facility ensures quality, basis weight uniformity, blending flexibility and engineering of specialty compositions. Papers are lightweight, flexible, compressible and easily die-cut.

**Auxiliary power unit insulation**

Setting the standard is our Flexible Min-K, one of the most thermally efficient insulations available. Flexible Min-K is used in the Auxiliary Power Unit (APU) endurance applications, and as thermal protection for the struts. The insulation prevents heat loss from the engine, thus improving internal operating temperature consistency, increasing operating efficiency, and protecting the outer casing. In the APU, Flexible Min-K is utilised as a fire barrier, due to its qualification in a standard 1000 °C, 15min performance test.

**Heat shields, electrical insulators, pump and valve components**

These products are made from Alumina which are commonly used in hydraulic systems as well as satellites and radar equipment, as they provide thermal and electrical insulation. Our materials enable products to be dimensionally stable, with excellent wear resistance which can withstand air temperatures of up to ~100 °C in minutes.

**Typical Thermal applications**

- Thrust Reverser Insulation
- Exhaust and Engine Coverings
- Engine air ducting
- De-icing systems
- Protecting sensitive instrumentation
- High temperature tubing and piping
- Hydraulic, fuel and oil lines
- Pylons
- Rocket Nose cone and structures
- Rocket Nozzles

**Fire protection solutions**

It is by combining exceptional capability with low weight and excellent thermal resistance that we are able to offer high performance aerospace solutions tailored to your needs. We provide these solutions through a unique approach to development and manufacturing. This approach incorporates the expansive knowledge of our materials engineers with your specific application requirements, ensuring that the end result is a material or product that is appropriate and directly meets your specifications.

**Micro-foil and flexible Min-K insulating tapes**

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.

**Min-K flex**

The Min-K family are the lightest, most thermally-efficient, high-temperature insulation products available on the market. Min-K Flex is used as a thermal barrier in thrust reversers, high-temperature ducting, and anywhere else heat-sensitive components need protection. It is ideal for high-vibration environments where weight and space are critical constraints.

**Thermocouple housings and fire detection feedthroughs**

Thermocouple housings and fire detection feedthroughs can handle extreme conditions while remaining specialised for individual tasks. Both are constructed from a variety of corrosion-resistant metal components and high-purity Alumina ceramic which yield stable hermiticity in severe environments. They are resistant to vibration and mechanical shock failure, making them well suited for aircraft engine applications.

**Superoxool® blanket**

Our ceramic fibre blankets come in various chemistries, densities and dimensions and are manufactured by both spinning and blowing processes. With both processes, the fibres are air laid and mechanically needled into high quality mats. Superoxool metal encased fibre blankets line oven chambers.

**Flexible Min-K assemblies**

Our molded Min-K products help manufacturers meet harsh fire protection requirements and safeguard electronics in catastrophic environments. Molded Min-K boards and shapes include an endothermic component to extend the time required for heat to reach the sensitive internals of flight data recorders in the event of a fire.

**Typical Fire Protection applications**

- Flight Data Recorders
- Fire Walls
- Nacelle Structures
- Engine exhaust and engine covering
- APU containers
- Oxygen systems protection
- Cargo systems
Morgan Advanced Materials manufactures electrical brushes in a range of carbon graphite and electrographitic materials designed to perform in the low humidity and hostile conditions that exist in high altitude operating environments. Our brushes are used in starters, alternators, auxiliary power units, generators, servo motors and fuel pump applications. Through the blending of select carbon and graphite materials with special purpose resins and metals such as copper and silver, our electrical brushes are specifically tailored to meet the needs of each application. Our scientists and experienced application engineers can advise on the most capable brush material to provide optimum performance in an application throughout the required operating altitude range.

Carbon Brushes

Morgan Advanced Materials provides custom solutions for a wide range of applications within the Aerospace Sector throughout fixed and rotary wing aircraft and missiles. Our products are tailored for specific conditions and are found in and around the engines and on the airframes. Our innovative carbon and graphite compositions deliver low friction and wear rates to support the increasing demands for efficiency and dependability.

Sealing rings are manufactured by Morgan Advanced Materials and used as bearing damper rings in hydraulic systems, valve and actuator assemblies and other critical sealing applications. A variety of customised materials are utilised depending on the application and range of service conditions. Various impregnations are utilised and are specified based on the needs of the application. Carbon face seals, circumferential seals and specialised labyrinth designs are commonly applied to contain the mainshaft bearing lubrication in turbine engines.

Diamond Like Carbon and DiamondShield™ coatings

DLC coatings are ideal for extending the service life of moving parts (Titanium, Stainless Steel, etc) by reducing wear and friction, whereas DiamondShield™ provides weight savings by giving plastic the hardness, abrasion resistance and resistance to chemical attack of glass. DLC is commonly used for pump shafts, rotors and seals within fuel injection systems of commercial and military aircraft, and DiamondShield™ can be used as a glass replacement.

Power transfer solutions for aerospace

Carbon / graphite seals and bearings

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Typical products and benefits: Carbon seals - dynamic seals

- Works at high speeds without seizure
- Reduced operational gaps/leaks under high temperature conditions
- Self-lubricating properties
- Possible on demand design

Carbon and graphite - bearings

- Self-lubricating properties to reduce friction and heat generation
- Reduced wear
- No seizing, even after long periods without use
- Operates at high temperatures
- Compatible with most aerospace fluids
- Can be impregnated for increased service life
- Can be shrink-fit for easier integration into the system

Profiled Components

Silicon Nitride provides major weight savings and life benefits due to its extremely high wear and temperature resistance, in comparison to standard stainless steel parts. This is a major benefit in aerospace applications for items such as landing gear and flap bearing mechanisms. Our highly tolerated and finished Silicon Nitride components can be profiled to any existing customer requirements.
Morgan Advanced Materials produces a wide range of solutions for the maintenance, repair and overhaul of aircraft. Our engineered materials and components are trusted around the world to ensure the safety of users through preventative or correction maintenance.

**Braze solutions for aerospace**

Morgan Advanced Materials produces a wide range of solutions for the maintenance, repair and overhaul of aircraft. Our engineered materials and components are trusted around the world to ensure the safety of users through preventative or correction maintenance.

**Braze alloys, melt spun foil, Pre-Sintered preforms and Stopyst® liquid**

Our range of precious and non-precious braze alloys come in either paste, wire, powder, foil or pre-forms. The active alloys we manufacture eliminate the need for intermediary metallisation on ceramics or composites to allow a complete metallurgical bond to metals, opening up a broad range of materials engineers can choose to join. Pre-sintered preforms (PSP) are excellent for crack repair and dimensional restoration of aerospace components such as blades and vanes. We also offer Stopyt® liquid which is a braze inhibitor suspended in an organic liquid, and when applied to a metal surface, prevents the unwanted flow of molten brazing alloys.

**Typical products**
- High temperature braze alloys
- Pre-sintered preforms (PSP)
- Ultinex® brazing service
- Stopyt® braze inhibitor

**Metal Repair Solutions**

**Pre-sintered Preforms**

Pre-sintered preforms are a sintered powder metallurgy product composed of a homogeneous mixture of a superalloy base material and braze alloy powder. Wesgo pre-sintered preforms are used to dimensionally restore and repair cracks on worn jet engine components.

**PSP application on a curved surface**

Typical superalloys used in presintered preforms
- IN738
- GH3536
- GH3538
- René 80
- Inconel 718

Typical braze alloys used in presintered preforms
- AD 91 H
- AMS4776
- AMS4778
- DF-3
- DF-4B
- DF-5
- Inconel 7188
- S578

**The benefits of Wesgo® PSPs**
- Low porosity
- Eliminates shrinkage
- Minimises re-braze cycles
- Minimises post-braze
- No shelf-life
- Better dimensional control
- Ease of use
- No messy components
- Easy to handle

**Ultinex® brazing solutions**

Ultinex® brazing frees up processing time which can translate into shorter lead-times, lower WIP and less fall out. Beyond that, material selection is opened up and can lead to higher performing designs and ultimately, better solutions. Ultinex® active brazing can join metals (Titanium, SST, molybdenum, Kovar, CH-FC copper etc), ceramics (zirconia, alumina, silicon carbide, RB5N, aluminium nitride, MACOR® etc) and non-metals (graphite, carbon fibre etc) with a strong chemical bond, which when done properly, results in the joint being as strong as the substrates.

**Active Brazing Technology**

From the earliest development to a steady stream of new active alloys to address challenging applications.

**Wesgo high purity alloys**

A trusted source for high purity, low vapour pressure alloys in stamped preforms, wire preforms, powder and more.

**Proprietary Ultinex® process**

Developed for a methodical approach to giving attention to the details that count.

**Concept to commercialisation**

Vigilance in early stage joint design can ensure a good joint and high yield process.

**High temperature capable material joining solutions**

**Metallised components**

We offer metallised and brazed components that are made from a range of Alumina materials which feature excellent properties such as dielectric strength and thermal shock resistance extending product life. Our metallised Alumina materials are used in pressure sensors and temperature sensors, whilst our thick film coated ceramics for UV emission detectors are an essential part of missile warning systems for military aircraft.

Our product range also includes brazed assemblies and feedthroughs which are utilised as hermetic connectors for power hybrid packages and fire detection.

We also offer ceramic-to-metal assemblies which are used in a variety of applications such as thermocouple housings that feature high terminal torque ratings increasing component reliability.
Sensor and avionic solutions

Drawing on expertise in advanced ceramic materials, piezoelectric ceramics and braze alloy innovation, Morgan Advanced Materials manufactures a range of products for aerospace sensors. These products range from components of sensors to complex sensor assemblies.

Typical products and applications

Hermetically sealed sensors
- High temperature capable metal to ceramic seals for sensor assemblies
- Thermocouple feedthrough assemblies
- Fire suppression system sensors
- Braze alloy technology for innovative hermetic joining of a broad range of ceramics, composites and metals
- Aerospace proven hermetically sealed sensor assemblies

High temperature sensors and sensor protection
- High temperature use junction boxes
- Electrical insulators that work through a range of temperature extremes
- Ceramics in electrical connectors, plugs and receptacles

Piezoelectric ceramic technologies
- Fluid level sensors in fuel systems
- Proximity sensors
- Counters
- Energy harvesting systems
- Active vibration management components
- Actuation
- Ultrasonic flow transducers
- Condition / health monitoring sensors
- Gyroscope guidance systems

High temperature frequency stable solutions for electrical filters

Additional aerospace products from Morgan

Fused Silica / zircon cores
We have a variety of refractory materials ranging from Fused Silica to Alumina designed to work in single crystal (SX), direct solidification (DS) and Equiax casting processes. These grades are designed to provide dimensional stability during the casting process which is vital in controlling cast metal wall thickness. Equally important to our customers’ engineers is the reduction of casting hot-tears which result in casting failures as they affect yield, productivity and cost.

Crucibles for investment casting
Our Molten Metal Systems business is the recognised worldwide for the supply of crucibles and foundry products to non-ferrous investment casters, die-casters and sand cast foundries. Our energy efficient and long life products enable the production of high quality molten metal to meet exacting casting specifications.

Precision alumina rods
Precision alumina rods from Morgan are ideally suited for use in the manufacture of ceramic cores used in investment casting for the aerospace sector. The extruded ceramic mold support rods and forming core rods can be used to support ceramic cores weighing from 45 to 450kg helping investment casting core placement and alignment. Parts are available in alumina and fused silica with a range of purities. Material grades can be selected to meet specific leachability requirements.

Glass beads for hermetic seals
Our glass beads provide finished seals used typically in hermetic packages for relays and fuses plus electronic printed circuit boards (PCBs) utilised on flight decks for both aircraft and spacecraft.
Morgan offers a wide range of products that are suitable for many different aerospace applications. The image below shows a variety of these and how they are used.

- **Graphite for High-Temperature Applications**: Graphite is used for high-temperature applications due to its low thermal conductivity and high temperature resistance. It is commonly used in aerospace applications such as engine blades and vanes.

- **Injection Molding**: Precision injection molding is used to produce high-quality plastic parts. These parts are used in various aerospace applications, including fuel pump assemblies, rotors, and seals.

- **Surface Treatments**: Techniques such as DLC (diamond-like carbon) coatings are used to extend the service life of moving parts by reducing wear and friction. These coatings are commonly used in aerospace applications to improve the performance of engine blades and vanes.

- **Segmented Barrier Seals**: These seals are designed to meet the requirements of high-temperature, high-vibration environments. They are used in aerospace applications, such as the thrust reverser insulation, where high-performance seals are critical.

- **Profiled Roller Bearings**: These bearings are made from silicon nitride and are used in a variety of aerospace applications due to their high temperature resistance and ability to operate at high speeds.

- **High-Precision Components**: High-precision components are used in various aerospace applications, including electronic printed circuit boards (PCBs), head-up displays, and structural components.

- **Superwool**: Superwool is a low-biopersistent material that provides major weight savings and life benefits due to its extremely high wear and temperature resistance. It is commonly used in catalytic environments where high-temperature, high-vibration conditions are present.

- **Min-K Insulation**: Min-K insulation is used to insulate areas where weight and temperature are critical. It is commonly used in high-temperature tubing and piping systems to prevent heat loss and protect surrounding components.

- **High-Temperature Graphite Pistons**: High-temperature graphite pistons are used in hot air bleed valves to provide high-temperature protection. They are used in a variety of aerospace applications, including commercial and military aircraft.

- **Metallized Components**: Metallized components are used in infrared detection, instrument panel lighting, and power hybrids within the cockpit.

- **High-Temperature Tapes**: High-temperature tapes are used to provide effective thermal and fire protection. They are commonly used in aerospace applications, including electronic printed circuit boards (PCBs) and head-up displays.
From heat shields and fuel level sensors, to wear resistant bearings and carbon brushes. Our innovative products are used where performance matters on aircraft around the world.