Vital thermal processing solutions for the **aerospace** and **defence** industries

Bodycote

Leading the industry in engineered specialist technologies and thermal processing solutions…

With a long serving history, Bodycote is partner to the leading aerospace companies. We deliver thermal processing solutions to improve functional performance and protect aerospace components from wear, abrasion, corrosion and high temperature environments. Count on us to solve your complex component challenges.

Thermal processing is a vital part of manufacturing processes and includes a variety of techniques and specialised engineering processes which improve the properties of metals and alloys and extend the life of components. Bodycote's services consist of the following core technologies: **heat treatment**, **hot isostatic pressing** and **surface technology**.

With superior expertise serving manufacturers' most challenging markets, our processes deliver unmatched repeatability for critical parts made from all types of materials using a wide variety of thermal processing methods.

Discover our interactive aerospace applications

The right treatment for metals, alloys and polymers...

Bodycote offers an extensive and unique range of heat treatments and specialist technologies to improve the performance and longevity of components for the aerospace industry. Our services provide thermal processing solutions across a wide range of applications which include general aviation; commercial, business and military aircraft; commercial and military helicopters, space and repair and rejuvenation of components.

COMMERCIAL JET

- Landing gear
- Engine
- Structure
- Actuation and control

SPACE

- Propulsion
- Engine
- Critical sensors
- Frame components

MILITARY AIRCRAFT

- Landing gear
- Engine
- Ejector seat
- Airframe

REPAIR AND REJUVENATION

In addition to thermal processing services for newly manufactured components, Bodycote can provide component repair and rejuvenation across the aviation industry.

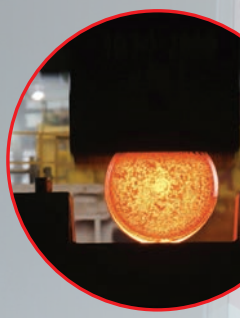
HELICOPTER

- Engine
- Main gear box
- Drive shaft
- Main rotor
- Flight control
- Landing gear

A component journey

Touch Down - Landing Gear

Safety critical landing gear must perform without fault every time the aircraft flies. A combination of thermal processing techniques is used to ensure the steel's material properties are optimised and to protect it during its working life. Traditionally, the landing gear has been surface treated using hard chrome plate, but this is now being superseded by more environmentally friendly thermal spray processes, which provide extreme wear and corrosion resistance.



Alloy Ti billet is forged to shape.

The part is heat treated to desired properties.

A thermally sprayed surface treatment is applied to replace hard chrome plate for improved wear and corrosion resistance.

The component is surface machined using diamond tools due to the extreme hardness of the surface finish.

End application
Aircraft.

Denotes the parts of the component journey undertaken by Bodycote

Solutions for your every need

Our aerospace solutions include Heat Treatments, Hot Isostatic Pressing and Surface Technology.

HEAT TREATMENT

Bodycote is the market leader in the vacuum heat treatment of aerospace components such as precision cast turbine blades. Controlled atmosphere heat treatment, case hardening or through hardening and tempering of components such as flap tracks, landing gear parts, flight control items and similar airframe and structural components, represent a significant proportion of the heat treatments carried out by Bodycote for aerospace manufacturers.

Key solutions:

Vacuum heat treatment:

- Ageing
- Annealing
- Homogenising
- Low Pressure Carburising (LPC)
- Plasma nitriding
- Single crystal vacuum heat treatment
- Solution treatment
- Brazing

Controlled atmosphere treatment:

- Carbonitriding
- Carburising
- Case hardening
- Corr-I-Dur®
- Gas nitriding
- Hardening and tempering
- Nitrocarburising

HOT ISOSTATIC PRESSING (HIP)

Component failure at 30,000ft is not an option. Closed porosity and voids in cast aerospace engine components are potential initiators of failure. These defects are effectively eliminated using Hot Isostatic Pressing.

Turbine blades and vanes from the high-temperature section of jet engines are routinely HIPed to ensure freedom from residual microporosity. HIP is used to optimise the properties of the latest generations of single crystal and directionally solidified investment cast blades. For parts that are subjected to high in-service stresses, the removal of porosity is essential to maximise the properties and working life of the component.

The demanding environment in aerospace applications, especially jet engines, has long required the use of Hot Isostatic Pressing to ensure consistent, defect-free material characteristics to support long-term high-integrity operations.

Working together with customers, Bodycote can provide cost-effective development of metal alloys using HIP technology. New classes of raw materials, such as metal matrix composites (MMCs), were developed using the HIP process. For example, an aluminium alloy matrix with a high proportion of silicon carbide ceramic particles may be compacted to full density by the HIP process to give a very light and stiff material. Many precision airframe castings from alloys such as titanium, aluminium and steel are HIPed to ensure integrity, optimise mechanical properties and improve fatigue life.

Key solutions:

- Densal® - aluminium densification
- Densification of superalloy and titanium castings
- Powdermet® manufacture of complex net and near-net-shape powder metallurgy components and novel materials
- Diffusion bonding of complex geometries
- HIP brazing
- HIP cladding

SURFACE TECHNOLOGY

Bodycote can provide surface technology solutions for a range of properties including wear control, corrosion resistance, thermal efficiency, and conductiveness to protect against lightning strikes. Without these surface treatments, today's aircraft components would not operate to the required standards. Our surface technology solutions extend component life, act as a thermal barrier to reduce material operating temperatures and improve engine efficiency.

Key solutions:

- HVOF (High Velocity Oxygen Fuel)
- Combustion spray
- Electric arc wire
- Liquid coatings – ceramic slurry spray, solid / dry-film lubricant
- Diffusion coatings – Vapour Phase Aluminide (VPA)
- Plasma spray
- Thermochemically-formed ceramics
- Ceramic densification
- Polymer and hybrid coatings

Our quality meets your standards

We maintain the highest production standards for quality, safety and efficiency, holding an extensive list of accreditations from key global customers, platforms, and standard agencies across all market sectors.

Bodycote holds all relevant international and national aerospace quality accreditations – such as Nadcap, ISO 9001, OHSAS18001 and ISO 14001 – as well as those of all the major aerospace companies, having preferred supplier status with many major aerospace companies, including Airbus, BAE Systems, Boeing, GE, Honeywell, Pratt & Whitney, Rolls-Royce.

Customers can be confident their demands can be met, however stringent, with assured quality, cost effectiveness and on time completion every time.

A greener future...

At every stage where Bodycote is involved in the manufacturing cycle, our operational aim is to lessen the overall impact on the environment, not just in our own operations, but also those of our customers.

Bodycote plays an essential role in minimising climate change. The services Bodycote supplies to its customers improve the lifespan of products and enable a reduction in the environmental footprint of their components. In addition, by efficiently aggregating our many thousands of customers' thermal processing requirements, Bodycote significantly reduces the overall required energy consumed compared with the energy that would be consumed if each customer treated their own products. In this regard, Bodycote can be considered to be an enabler of the reduction in global industrial carbon emissions.

Bodycote is committed to reducing its overall carbon footprint in line with the Science Based Targets initiative (SBTi).

Certain processes, such as thermal spray surface treatments, are leading the way in the replacement of older, less environmentally friendly processes. Thermal spray is replacing many applications of hard plating, such as the hard chrome plating of landing gear, and is increasingly being specified by companies that are environmentally aware.

The restrictions on chrome plating due to health and safety and environmental issues have led to major aerospace companies embarking on initiatives to replace it. Aerospace companies have highlighted thermal spray coatings as the preferred replacement for chrome plating. Bodycote has been involved in a number of initiatives to replace chrome plate and results have shown that, in addition to the environmental benefits, thermally sprayed tungsten carbide based coatings outperform hard chrome plate for both wear and corrosion protection.

Modern thermal processing techniques have allowed design engineers and manufacturers to use much lighter materials, such as aluminium and titanium, and have significantly prolonged component lifetimes. Through the effective use of thermal processing, parts can now be lighter and overall component weight reduced, leading to improved efficiency and reduced fuel consumption.

At every stage where Bodycote is involved in the manufacturing cycle, our operational aim is to lessen the overall impact on the environment, not just in our own operations, but also those of our customers.

By utilising Bodycote's services, our customers are able to reduce their overall carbon footprint. By outsourcing to Bodycote, customers reduce their Scope 1 & 2 emissions and our efficient processes represent a significantly lower Scope 3 carbon impact.

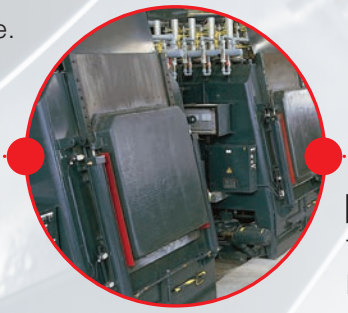
Without Bodycote, many companies would be using older technology in-house and running their equipment at reduced capacity, both of which are a drain on energy and financial resources. Working with Bodycote enables our customers to commit more easily to carbon reduction initiatives. In many jurisdictions this can lead to additional value generation as carbon reduction legislation is brought into force.

A component journey

Safety Critical Service - Engine Shaft

The main drive shaft in a civil aircraft engine is a safety critical component. In service, part failure could mean disaster. Thermal processing is essential to ensure this part has the necessary material properties to operate effectively, keeping the aircraft in the air.

The component begins life as a steel bar from which a forging is made.



Rough machining is carried out, usually to within 1/16th inch of the final part size.

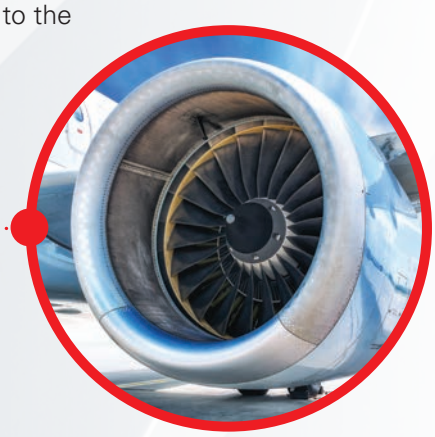
The forged shaft is hardened and tempered to give the correct tensile strength.

The shaft is stabilised at approximately 50°C below the final tempering temperature to remove any machining stresses.

The part undergoes final machining and grinding.

Areas that do not require surface hardening are masked using bronze, tin or copper plating, and the shaft is then gas nitrided at a temperature not exceeding the stabilising temperature. This diffuses nitrogen on to the surface to provide high hardness and excellent wear resistance.

Post-nitriding, the plating and the white layer (nitrogen-rich layer which does not diffuse on to the surface) are removed.



End application
Aircraft, or land-based gas turbine, engine.

Denotes the parts of the component journey undertaken by Bodycote

www.bodycote.com

Operating an international network of facilities and serving a wide range of industries, Bodycote is the world's largest and most trusted provider of thermal processing services – a vital link in the manufacturing supply chain.

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