

TECVAC

Nitron™ Flight



*High performance coatings for
aerospace components*

Visit us on Stand G1 Hall 4

Farnborough International Airshow 19–25 July 2010



*Advanced PVD/CVD coatings that enhance performance for engine systems and airframe components
TiN, CrN, CrAlN, DLC, WC-C, CRN*

Tecvac provides advanced PVD surface coatings to enhance the performance of aerospace components in airframe, system and engine applications. This includes TiN, CrN, CrAlN, DLC, WC-C in single, hybrid and multilayer configurations. Existing aerospace clients are realising the improvement in overall component performance in terms of reduced wear, reduced friction, improved corrosion and anti galling properties. Tecvac offers a quick turnaround coating service operation as well as offering consultancy services and development contracts. Tecvac standards include ISO 9001-2000. Tecvac is NADCAP approved for coating and testing services and holds specific aerospace awards.

Tecvac Limited are the only company who can offer NADCAP approved, Nitron™ Flight, high performance physical vapour deposition (PVD/CVD) coatings. Our advanced range of Nitron™ Flight coatings can help manufacturers and operators (both civil and military) to:

- reduce life cost of ownership
- increase aircraft and mission availability
- become more environmentally friendly in an era of ever increasing costs of aviation fuel and scarce material resources.

Our Nitron™ Flight anti-erosion coatings can:

- assist you to maintain your engine’s optimised specific fuel consumption (SFC) for longer – saving fuel, reducing emissions.
- enable your rotatables to remain ‘on-wing/in operational service’ for longer.
- resolve your material interface issues, enabling weight-saving combinations of material to be utilised in aerospace and defence applications.

Erosion protection

Tecvac Limited are approved for coating and testing services with ISO 9001:2000, BSEN 9100:2003 and PRI NADCAP Approvals. We are already approved by Rolls-Royce who have our coatings in service, to offer a level of anti-erosion protection on various compressor stages of one of their commercial aero engine programmes. Our coatings are now on the Airbus A380 programme, where we provide PVD coatings for Ti/Ti surfaces on undercarriage bearings.

Tecvac’s coatings are also used in a number of other aerospace/defence/space related applications. Other components coated with Nitron™ Flight include actuation components, aileron control arms, bearings – engine/undercarriage, control systems, fuel systems and valve components.

We are now working with major bearing manufacturers, global aerospace OEMs and UK Ministry of Defence who all understand the benefits that they can achieve from our range of Nitron™ Flight, high performance, PVD coatings. Engine components are good candidates for the applications of our coatings – the following is an indication of a typical application:

Component	Titanium and nickel alloy compressor rotor blades and stator vanes
Coatings	Nitron™ Flight A/Nitron™ Flight B to reduce blade erosion from hard particles
Thickness	6µm to 8µm multi layers
Notes	The Nitron™ Flight coating has advantages in this application because the coating is very smooth and relatively free from defects. The low stress, thin film coatings counter any potential delamination



Find out more today and let Tecvac’s coatings help you to maximise your time between overhauls (TBOs), reduce your inventory costs, develop weight-saving world-class design solutions and minimise operational costs. Visit www.tecvac.com for more information.

Reducing fuel consumption

Understandably, aerospace designers and manufacturers have seen a change in design objectives over the last twenty years in terms of overall efficiency improvement requirements such as reduced fuel consumption and lower emissions. The use of coatings to provide a support and wear resistant barrier for the substrate has had a significant input into this improvement in overall efficiency. Coatings allow engineers to look at less dense materials and more optimised, lower weight designs in their quest for minimising non-payload weight.

The Advisory Council for Aeronautics Research in Europe (ACARE) *Clean Sky* initiative has set challenging targets for the aeronautics and air transport Industry to be reached by 2020, which include:

- 50% reduction of CO₂ emissions through drastic reduction of fuel consumption per passenger kilometer
- 80% reduction of NO_x (nitrogen oxide) emissions.

Coatings have played a major part in aero engine design improvements and will continue to play a significant role in future design decisions by providing economic and safety benefits to aero-engine components and aerospace components and structures. In the future, typically over 50% of long haul operating costs will be engine related (fuel burn/engine ownership/engine maintenance). Tecvac's Nitron™ Flight, High Performance, PVD coatings will help to keep these costs down and will contribute to the achievement of the environmental targets for the reduction of both CO₂ and NO_x emissions by 2020.

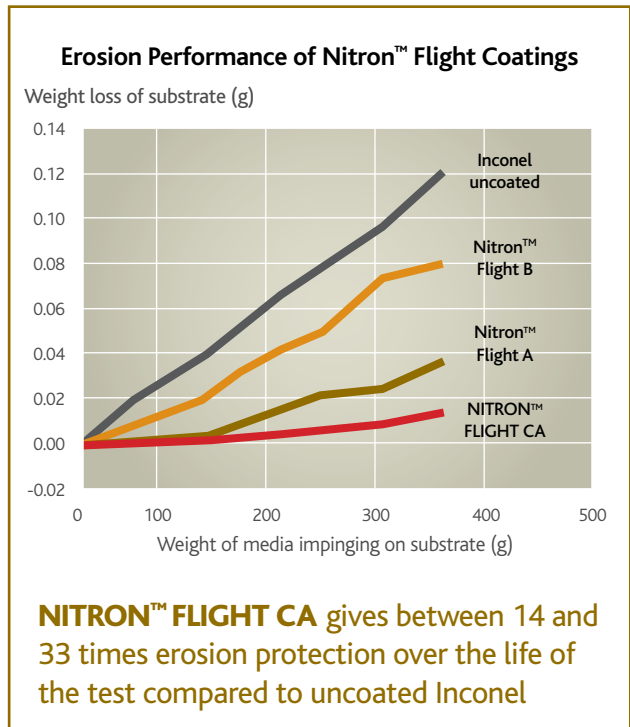
In general, the effect of multilayer coating super-finished compression blades is to improve the specific fuel consumption by 0.2– 1.0%. Specific fuel consumption (SFC) is the measure of the amount of fuel to produce one unit of power.

Performance and advanced repairs will play a greater role now and in the future as fuel and material costs continue to escalate. Therefore the ability to obtain more life from existing components is vital to sustain efficiencies. The use of re-usable, sacrificial PVD coatings, to maintain the enhanced surface finish of compressor blades and vanes for a longer period of operational life between overhauls, can demonstrate significant fuel savings over the lifetime of an engine.

A full coating portfolio

In addition to the coating of propulsion components, Tecvac offer a range of coatings which can enhance the performance of other aerospace parts such as bearings, seals, valves, actuation components and fasteners.

Titanium alloys have exceptional strength-to-weight ratios, good fatigue strength and outstanding corrosion resistance. However these alloys have poor tribological properties resulting in premature failure in service due to abrasive and adhesive wear.



Nitron™ Flight B



Nitron™ Flight A



Nitron™ Flight CA

In lightly loaded applications the performance can be greatly improved by coating with standard PVD Titanium Nitride (TiN), however, at higher loadings the inherent softness of the substrate can result in early failure – therefore a duplex process, which can enhance the surface hardness of the Ti alloy, is required.

Tecvac have developed the Nitron™ Flight O process to solve this problem. The components are treated using a twin heat treatment-deposition process in which a diffusion zone-rich in metal nitrides is formed beneath the PVD hard coating.

Coatings assist-weight reduction

In a three year programme in partnership with Airbus and NMB Minebea we have further developed the initial duplex process to facilitate the substitution of steel with titanium by enabling large weight savings. The surface modification allows bearing loading up to 150 MPa.

This novel technology results in coatings which are highly adherent and fully supported by a hardened sub-surface layer. The resultant effect is a vastly improved wear resistance with a concomitant improvement in service performance. Evidence of this effect can be seen in the two graphs shown below.

Nitron™ Flight CA offers real performance benefits for compressor blades and vanes. However, its capabilities in high load bearing and elevated temperature applications makes it also beneficial for valve components, fasteners and high temperature seals as well as landing gear and engine bearings.

Carbon coatings – improving sliding and rolling performance

Nitron™ Flight MC – a WC/C based amorphous carbon coating (Me-C:H) is a derivative of pure Diamond-Like-Carbon (DLC) coatings. MC is a relatively low hardness (~1200 VHN) but extremely lubricious coating suited to provide exceptional performance in medium to high loading conditions for instance bearings operating up to 2000N/mm². The low coefficient of dry friction <0.1 means that the uncoated mating part is also protected against wear under sliding stress. Coating both contact surfaces improves the CoF still further by a factor of two. Nitron™ Flight MC is applied at temperatures of 250°C so it can be used to coat sensitive heat treated components. Its inherently low friction coefficient renders it an excellent coating choice for fasteners, gear wheels and actuator roller bearings. Frictional properties can be further enhanced by utilising Nitron Lubrica, a dry film lubricant coating.

Coating internal bores

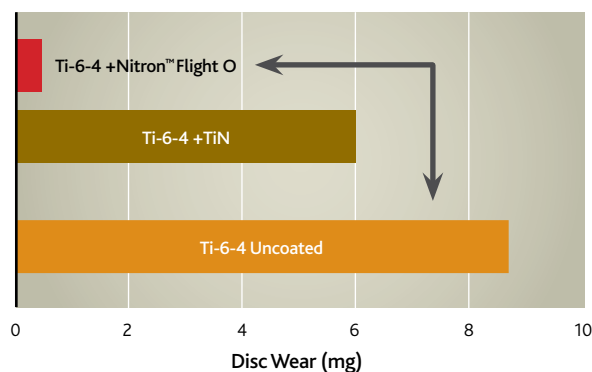
In a new development – we now have the capability to coat internal surfaces such as sleeves, tubes and cylinders. Using the novel InnerArmor™ DLC – film thickness up to 50µm will afford excellent erosive and abrasive wear protection as well as rendering the surfaces immune to corrosive attack. InnerArmor is unique in bore coatings in providing a consistent, repeatable pinhole free layer allowing the coated component to meet a wide range of arduous duties.



Nitron™ Flight Coatings on compressor blades subject to particle erosion, provides protection against critical shape changes and distortions at the airfoil leading edges, and against degradation of the surface that, without protection, can otherwise have a large effect on the aerodynamic efficiency of the compressor.

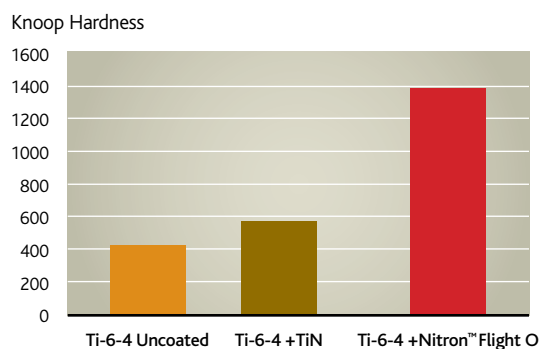
Tecvac Limited's Nitron™ Flight Coating in conjunction with a super finished substrate helps ensure mission readiness, maintained performance, operator safety, and optimal life cycle costs.

Sliding wear comparison of uncoated Ti-6-4 vs TiN coated and Nitron™ Flight O coated



Knoop hardness values for 100g load

Titanium alloy uncoated/TiN coated/Nitron™ Flight O coated



TECVAC

www.tecvac.com

Telephone +44 (0)1954 233700 Fax +44 (0)1954 233733 E-mail aerospace@tecvac.com

Tecvac Ltd, Buckingham Business Park, Swavesey, Cambridge, CB24 4UG