

Aviation



*Coating Applications
for Gas Turbine Engines*



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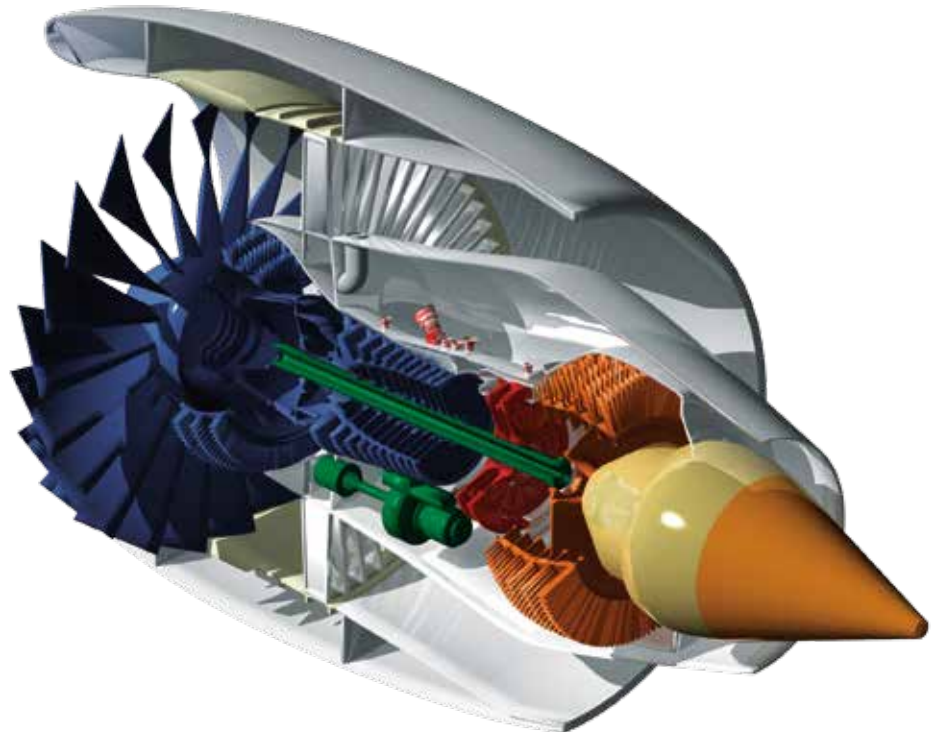
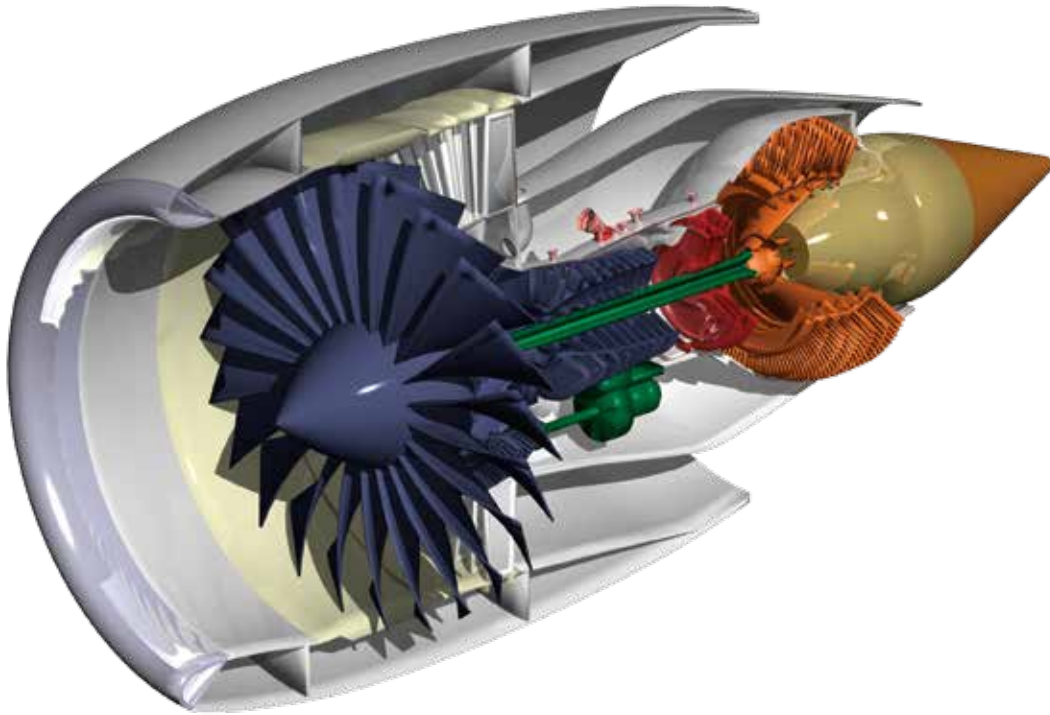
Afterburner Section (not illustrated)

Combustion Section

Bearings & Accessories

Turbine Section

Compressor Section



Afterburner Section (not illustrated)

Part Name	Coated Area	Typical Coating Type	Typical Mating Surface	Typical Objective of Coating
Afterburner Actuator Piston Rod	O.D. of rod	Tungsten carbide LW-1N40	Cast iron seal rings	Sliding, fretting wear resistance
Afterburner Combustion Chamber Liner	Interior surface	Thermal barrier LTB-8	Hot gases	Thermal barrier
Afterburner Fuel Pump Impeller	Bearing journals	Tungsten carbide LW-1N40	Seal	Sliding wear resistance
Afterburner Nozzle Support Assembly	Bearing surfaces	Chrome carbide LC-1B, LC-18	Self-mating, coated nozzle segments	Fretting wear resistance
Afterburner Seals, Flaps and Nozzle Segments	Bearing surfaces	Chrome carbide LC-1B, LC-18	Self-mating, coated bearing surfaces	Fretting wear resistance
Afterburner Seals, Flaps and Nozzle Segments	Flame impingement surfaces	Thermal barrier LTB-8B	Hot gases	Thermal barrier
Afterburner Spray Bars	O.D. bearing surfaces	Chrome carbide LC-1B	Cobalt alloy bushing	Fretting resistance
Afterburner Spray Bars (Afterburner Tubes)	Nozzle ring	SermaLoy™ slurry aluminide	Hot exhaust gases	High-temperature oxidation resistance

Combustion Section

Part Name	Coated Area	Typical Coating Type	Typical Mating Surface	Typical Objective of Coating
Combustion Chamber Assembly, Liners and Domes	Interior surfaces	Thermal barrier, LTB-8, LTB-12, LTB-13, LTB-16, Tribomet® MCrAlY	Hot gases	Thermal barrier
Combustion Chamber Cases	O.D. (non-gas path) surfaces	SermeTel® 2241 Al-ceramic coating; SermaLoy J slurry aluminide	Ambient environment	Corrosion resistance
Combustion Chamber Clamp	I.D. gripping surface	Chrome carbide LC-1B, LC-18, Tribomet® T104CS	Self-mating, coated combustion chamber liner O.D.	Fretting wear resistance
Combustion Chamber Liner	O.D. surface	Chrome carbide LC-1B, Tribomet® T104CS	Self-mating, coated combustion chamber clamp I.D.	Fretting wear resistance
Combustion Chamber Positioning Pin	Bearing surfaces	Tungsten carbide LW-1N40; Chrome carbide LC-1B	Self-mating, coated bearing surfaces	Fretting wear resistance
Combustion Chamber Support Assembly	I.D. bearing surfaces	Chrome carbide LC-1B, LC-18	Self-mating, coated liners and guides	Fretting wear resistance
Fuel Nozzle Nut	O.D. bearing surfaces	Chrome carbide LC-1B, LC-18	Self-mating, coated I.D. of swirler	Fretting wear resistance
Fuel Nozzle Nut	Threads on I.D.	Copper-nickel-indium LCN-1	Threads on fuel manifold	Preventing nozzle nut loosening
Fuel Nozzle Nut	Threads on I.D.	SermaLoy™ J slurry aluminide	Hot air, fuel	Oxidation and sulphidation resistance
Fuel Swirler	I.D. bearing surfaces	Chrome carbide LC-1B, LC-18	Self-mating, coated O.D.	Fretting wear resistance
Thermocouple Probes	Gas path	SermaLoy™ J slurry aluminide	Hot gases	Oxidation and sulphidation resistance

Bearings & Accessories

Part Name	Coated Area	Typical Coating Type	Typical Mating Surface	Typical Objective of Coating
Bearing Housings & Seal Assemblies	I.D. sealing surfaces	Chrome carbide LC-1C; Tungsten carbide LW-1	Carbon rings	Sliding wear resistance
Bearing Rings	Bearing surfaces	Titanium nitride 24K	Housings	Fretting wear resistance
Bearing Seal Housings	I.D. secondary seal area	Tungsten carbide LW-1N30, LW-1N40	Tungsten carbide coated seal rings	Fretting wear resistance
Bearing Seal Seats & Spacers	Annular sealing face	Chrome carbide LC-1C; Tungsten carbide LW-1	Carbon-graphite seal	Sliding wear (both surfaces) resistance
Bearing Supports	Non-contact areas	SermeTel® W, 2F-1, 5380, 5380DP Al-ceramic coatings	—	Corrosion resistance
Gearbox Support Pins, Bushings & Lugs	Bearing surfaces	Tungsten carbide LW-1N40	Self-mating, coated bearing surfaces	Fretting resistance
Labyrinth Seal Fins & Seal Teeth	Knife-edge tips and face	Tungsten carbide LW-1N40; chrome carbide LC-1B; aluminum oxide LA-2, LA-21; Tribomet® CBN abrasive	Porous metal, honeycomb or abrasible coatings	Rubbing wear resistance
Main Shaft Bearings	Bearing shoulders	Titanium nitride 24K	Bearing cage, silver-plated	Sliding wear resistance
Oil Pump Gears	O.D. bearing journals	Tungsten carbide LW-1N40	Bronze bushing or aluminum housing	Fretting wear resistance
Oil Scavenge & Breather Tubes	O.D. sealing surfaces	Tungsten carbide LW-1N40	Steel	Fretting wear resistance

Turbine Section

Part Name	Coated Area	Typical Coating Type	Typical Mating Surface	Typical Objective of Coating
Air Sealing Rings	Annular surfaces	Chrome carbide LC-1B, LC-18; Tribomet® T104CS, cobalt alumina LCO-17	Self-mating, coated annular services	Fretting wear resistance
Exhaust Fairing Pins & Bushings	Bearing surfaces	Tungsten carbide LW-1N40	Self-mating, bearing surfaces	Fretting wear resistance
Outer Airseals & Turbine Shrouds	I.D. sealing surface	Cobalt alloy LCO-22, Mar M-509, thermal barrier LTB-8, LTB-13	Blade tip	Rub-tolerant surface for sealing; thermal barrier with erosion resistance
Outer Airseals & Turbine Shrouds	Inside diameters	Chrome carbide LC-1B	Air flow	Erosion resistance (against catalyst particles in expanding gases)
Outer Airseals & Turbine Shrouds	Gas path surfaces	Aluminides - SDC 1544,1567,1572,1573	Hot gases	Oxidation and sulphidation resistance
Thrust Frame Boss & Clevis	Bearing surfaces	Tungsten carbide LW-1N40	Self-mating, bearing surfaces	Fretting wear resistance
Turbine Blades	Unshrouded tip	Cobalt alumina LCO-17; Tribomet® CBN abrasive	Honeycomb, porous metal, nickel-base alloy	Rubbing wear resistance
Turbine Blades	Top side of shrouded tip	Cobalt alumina LCO-17	Outer airseal	Rubbing wear resistance
Turbine Blades	Shroud Z-notches and knife-edge seals	Chrome carbide LC-1B; cobalt alumina LCO-17, LCO-19, L-10; Tribaloy* LDT-800	Self-mating, interlocking shrouds	Fretting wear resistance above 1000° F (538° C)
Turbine Blades	Shroud Z-notches and knife-edge seals	Tungsten carbide LW-1N40	Self-mating, interlocking shrouds	Fretting wear resistance below 1000° F (538° C)
Turbine Blades Underplatform	Underside of platform	PWA 545 slurry, cathodic arc coatings, chromizing and chrome aluminizing	Hot gases	Hot corrosion, SCC resistance
Turbine Blade Tips	Turbine blade tip	Tribomet® MCrAlY and abrasive tip, STCC ceramic cutting tip	Abradable seal material	Sealing at tip of turbine blade
Turbine Blades & Vanes	Airfoil & platform gas path surfaces	Cobalt alloy LCO-22, LCO-29; Thermal barrier LTB-8, LTB-13, LTB-19; MCrAlY overlays; EBPVD, EBPVD YSZ; Platinum aluminide, Vapor phase aluminide (PWA 273, 275); Pack aluminides (PWA 44, 73, 252 RPS 320); Pack chromide (F50TF37, PWA 70); SermaLoy™ J slurry aluminides, Tribomet® MCrAlY	Hot gases	Oxidation and sulphidation resistance; thermal barrier
Turbine Blades & Vanes	Internal cooling passages	Vapor phase aluminide; SermAlcote™ 2500, 2525 slurry aluminide, PWA 273 slurry, pack aluminides where access permits; also vapor chromizing	Hot gases	Internal cooling passage oxidation and corrosion resistance
Turbine Blades & Vanes	Damaged coating on airfoil & platform gas path surfaces	SermaLoy™ J slurry aluminide	Hot gases	Repair of protective coating layers
Turbine Blades & Vanes	Airfoil & platform surfaces	Cobalt alloy LCO-22, LCO-29; Thermal barrier LTB-8, LTB-13, LTB-19; MCrAlY Overlays; EBPVD; Platinum aluminide; Vapor phase aluminide	Hot gases	Oxidation and sulphidation resistance; thermal barrier
Turbine Brush Seals	Airfoil & platform surfaces	Chrome carbide LC-1B	Hot gases	Erosion resistance (against catalyst particles in expanding gases)
Turbine Brush Seals	Bearing surfaces	Chrome carbide LC-1B, LC-1H	Seal bristles	Sliding & brush wear resistance
Turbine Stator Shrouds	Shroud flanges	Chrome carbide LC-1B, LC-18; Cobalt alumina LCO-17, LCO-19, L-103	Self-mating, coated vane inner-foot pads	Fretting wear resistance
Turbine Vanes	Inner-foot pads	Chrome carbide LC-1B, LC-18; Cobalt alumina LCO-17, LCO-19, L-103	Self-mating, coated stator shroud flanges	Fretting wear resistance
Turbine Exhaust Case	Gas path surfaces	SermeTel® 2241 Al-ceramic coatings	—	Corrosion resistance
Turbine Nozzle Case	Gas path surfaces	SermeTel® 2241 Al-ceramic coatings	—	Corrosion resistance

Compressor Section

Part Name	Coated Area	Typical Coating Type	Typical Mating Surface	Typical Objective of Coating
Bevel Gear, Gearbox Drive	I.D. bearing surface	Tungsten carbide LW-1N40	Self-mating, coated hub O.D.	Fretting wear resistance
Bleed Manifold Expansion Joint Liners & Sleeves	O.D. & I.D. sealing surfaces	Tungsten carbide LW-1N40	Seal mating, coated seal rings	Sliding, fretting resistance
Compressor Blades	Blade tips of outer airfoil section	Alumina+titania LA-229; Aluminum oxide LA-2; Zircote®, Tribomet® abrasive tip	Compressor case or abrasible coating	Overheating, wear resistance
Compressor Blades	Airfoils	Tungsten carbide LW-2A, LW-1N30, SDG 2002, Titanium nitride 24K; Chrome carbide LC-1H	Air flow	Solid particle erosion (with mineral fatigue) resistance
Compressor Blades, Vanes & Stators	Airfoil gas path surfaces	SermeTel® W, 725, 2F-1, 6F-1 Al-ceramic coatings	Intake air	Corrosion resistance
Compressor Blades, Vanes & Stators	Airfoil gas path surfaces	SermeTel® 5375, 5380DP, SermaFlow™ S4000, SermaLon® Al-ceramic coatings	Intake air	Corrosion, fouling resistance; aerodynamically smooth surface
Compressor Blades, Vanes & Stators	Airfoil gas path surfaces	SDC 1577 diffused aluminide	Intake air	Corrosion and oxidation resistance to 550°C
Compressor Blades, Vanes & Stators	Airfoil gas path surfaces	SermaFlow™ N3000 ceramic barrier coating;	Intake air	Aerodynamically smooth surface; hot corrosion and fouling resistance to 700°C (LTHC)
Compressor Blisks	Airfoil gas path surfaces	SermeTel® 5380, 5380 DP Al-ceramic coatings	–	Fouling, corrosion and oxidation resistance
Compressor Case	Flanges	Tungsten carbide LW-1N40	Self-mating with adjacent case	Fretting wear resistance
Compressor Case	Entire case	SermeTel® W, 2241, 2242, 5380, 5380 DP, 725 Al-ceramic coatings	Intake air	Corrosion and oxidation resistance to 550°C
Compressor Case	Seal surfaces on I.D.	Ni-graphite, Al-polyester	Compressor blade tip	Sealing
Compressor Hubs	Bearing journal diameters	Tungsten carbide LW-1N40	Bearing inner races & tungsten carbide coated bevel gear I.D.	Fretting wear resistance
Compressor Hubs & Disks	Snap diameters	Tungsten carbide LW-1N40	Spacer snap diameters	Fretting wear resistance
Compressor Hubs & Disks	Most areas	SermeTel® W, 2241, 5380DP Al-ceramic coatings; SDC 1577 diffused aluminides	Compressor/fan shaft; blade roots	Corrosion and oxidation resistance to 550°C
Compressor Hubs & Disks	Blade slots	Dry film lubricants	Blade roots	Fretting resistance; removal assurance at overhaul
Compressor Spacers	Most areas	SermeTel® W, 2241, 5380 DP Al-ceramic coatings	Intake air	Corrosion and oxidation resistance to 550°C
Compressor Rotor Tube and Sleeves	Seal ring grooves and lands	Tungsten carbide LW-1N40	Seal rings & tungsten carbide coated hub bushing	Fretting wear resistance
Compressor Seals	Gas path and non-contact areas	SermeTel® W, 2241, 5380 DP Al-ceramic coatings	–	LTHC, corrosion resistance
Compressor Rings	Gas path and non-contact areas	SermeTel® W, 2241 Al-ceramic coatings; SermaFlow™ N3000 ceramic barrier coating	–	Corrosion, fouling and hot corrosion resistance
Diffusers, Impellers & Vane Sectors	Vane surfaces	Tungsten carbide LW-1N30, LW-2A, SDG 2002; Titanium nitride 24K; Tribomet®	Air flow	Particle erosion resistance with minimal fatigue debit
Diffuser Case	Gas path	SermeTel® W, 2241, Al-ceramic coatings	–	Corrosion and oxidation resistance to 550°C
Fan Blades & Compressor Blades	Midspan shroud pads	Tungsten carbide LW-1N40, SDG 2040	Self-mating, coated pads	High-load, high-frequency fretting wear and cracking resistance; minimal fatigue debit
Fan Blades & Compressor Blades & Vanes	Root & foot section pressure faces	Copper-nickel-indium LCN-1; aluminum bronze LCU-2	Titanium, steel, nickel, alloy, disks & housings	Galling, fretting wear resistance
Gas Generator Case	Entire case	SermeTel® 5380 DP Al-ceramic coating	Intake, compressed air	Corrosion and oxidation to 550°C
HPC Stators	Snap diameters	Stellite* LS-31A; aluminum bronze LCU-2	Titanium steel	Galling, fretting wear resistance
Inlet Guide Vanes (IGVs)	Trunnions	Nickel-aluminum LN-5B	Self-mating, coated bearing surfaces	Wear, corrosion resistance
Inlet Guide Vanes (IGVs)	Airfoil surfaces	SermeTel® 5375, 5380DP, SermaFlow™ S4000 Al-ceramic coatings	–	Corrosion resistance; aerodynamically smooth surface
Variable Guide Vanes (VGVs)	Bearing surfaces, trunnions, drive arms, sync ring	Tungsten carbide LW-1N40	Self-mating, coated bearing surfaces	Fretting wear resistance
Variable Guide Vanes (VGVs)	Airfoil surfaces	SermeTel® 5375, 5380DP, SermaFlow™ S4000 Al-ceramic coatings	–	Corrosion resistance; aerodynamic surface finish
Front Frames	O.D. and gas path surfaces	SermeTel® W, 725, 2F-1, 6F-1 Al-ceramic coatings	Intake air	Corrosion resistance
Shafts	I.D. and O.D. surfaces	SermeTel® W, 2241, 1083/1140, 984/985 Al-ceramic coatings	Hot oils, hydraulic fluids	Corrosion and oxidation resistance to 550°C

A close-up, low-angle shot of an aircraft's engine and fuselage. The engine's fan blades are visible on the right, and the fuselage with its windows extends into the background on the left. The lighting is bright, suggesting an outdoor setting.

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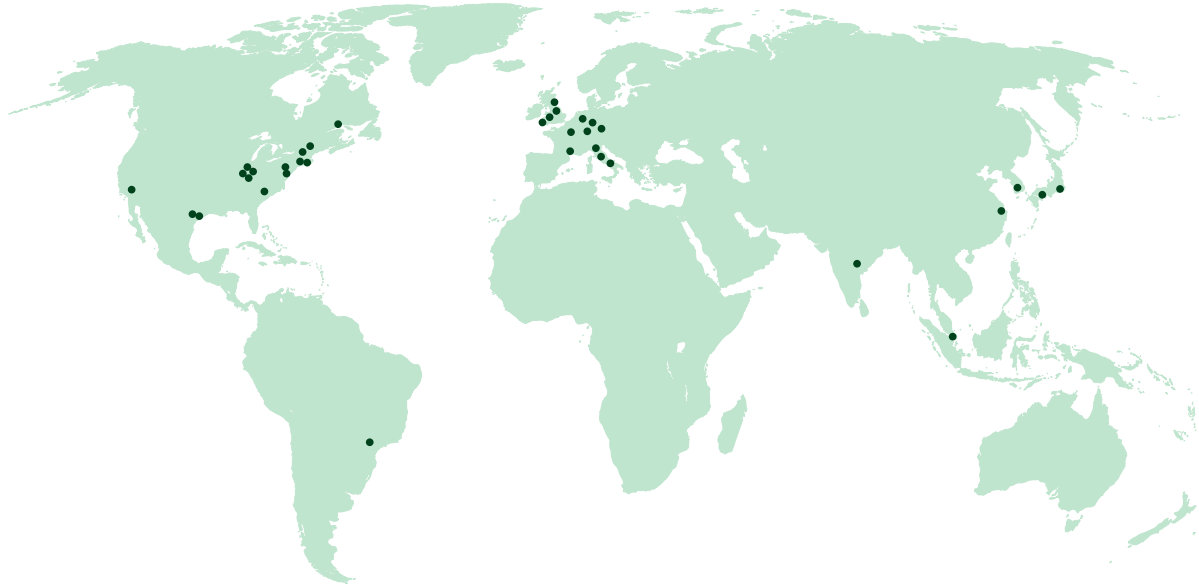


Aircraft Engine Applications

- Actuator components
- Afterburner assemblies
- Bearings and accessories
- Combustion chambers
- Combustion flame tubes
- Compressor air foils
- Compressor drums
- Discs and shafts
- Fuel nozzles and swirlers
- Rim cover plates
- Rings and seals
- Turbine air foils
- Turbine discs
- Turbine shrouds

Aviation

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✈ Schluechtern, Germany Tel. +49.6661.96780		United States ✈ Compton, CA Tel. 310.604.0018	Houston, TX ✈ Tel. 713.849.9474 ✈ Tel. 713.991.8700

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Praxair Surface Technologies, Inc.
1500 Polco Street
Indianapolis, IN 46222
USA

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Telephone: +1.317.240.2500
Fax: +1.317.240.2255

www.praxairsurfacetechologies.com
info@praxair.com