



HENKEL AEROSPACE SOLUTIONS DESIGNED FOR KEY AVIATION PRINCIPLES.

CARLOS QUINTERO





HENKEL COMPANY

AEROSPACE TECHNOLOGIES



- **150 years old** German multinational **chemical and consumer goods company** headquartered in Düsseldorf, Germany.



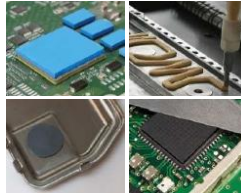
- Within **Adhesives Technologies** we found **Aerospace Solutions**



**STRUCTURAL
ADHESIVES**



**SURFACE
TREATMENT**



ELECTRONICS

- Henkel holds **leading positions in both industrial and consumer businesses.**



- **Main Aerospace portfolio products:**

LOCTITE® **BONDERITE®**



HENKEL AEROSPACE PRODUCT NAMES

PRODUCT NAME	PREVIOUSLY KNOWN AS
BONDERITE	ALODINE
BONDERITE	TURCO
BONDERITE	RIDOLINE
BONDERITE	ACHESON
BONDERITE	ALUMINUX
BONDERITE	ANOSEAL
BONDERITE	MULTAN
BONDERITE	RIDOLINE
LOCTITE FREKOTE	FREKOTE
LOCTITE	HYSOL
LOCTITE	SYNCORE
LOCTITE	SYNSPAND

BONDERITE®

- AERO SURFACE TREATMENT

LOCTITE®

- AERO STRUCTURAL ADHESIVES

LOCTITE

Frekote®

- AERO MOLD RELEASE AGENTS

FLIGHT 4 FORCES

Lift, Weight, Thrust, and Drag — are constantly at play every time an aircraft takes to the skies.



To optimize these forces, **reducing** the aircraft's **Weight is essential**.

Advanced adhesives and composite materials can significantly **lower aircraft mass**.

Henkel's aerospace structural adhesives play a critical role from bonding and assembly to surface preparation. These solutions help **reduce overall weight**.

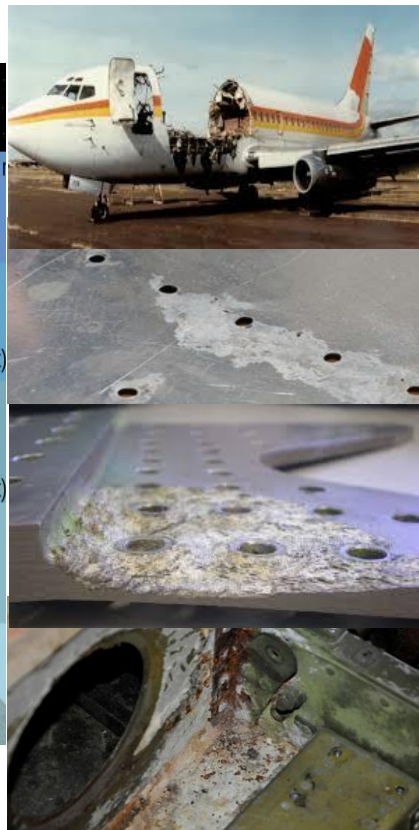
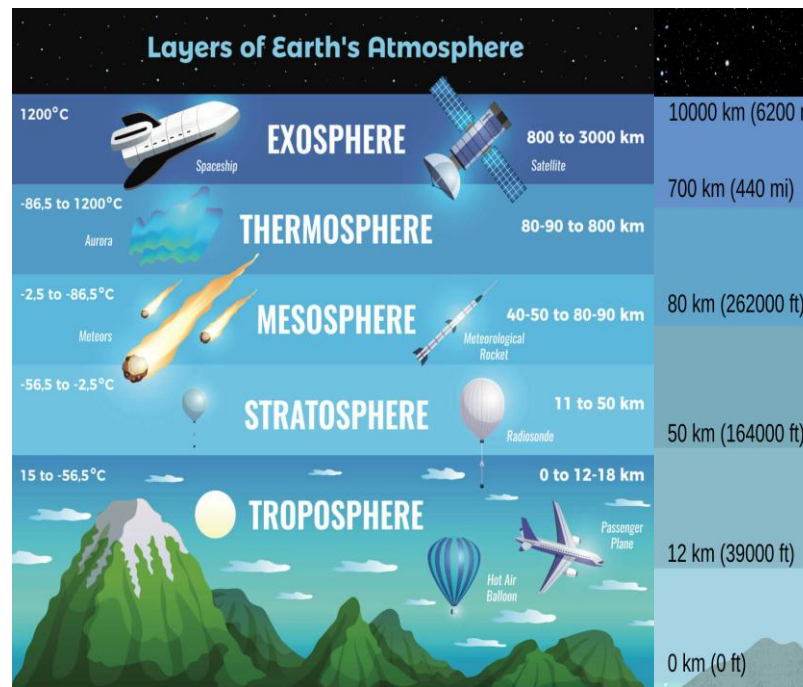
Less weight means less thrust required for lift, **reducing fuel consumption** improving performance.

Greater efficiency means more **sustainable aviation**

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ATMOSPHERIC LAYERS IMPACT ON AVIATION

The Earth's atmosphere has five main layers, with the troposphere and stratosphere being most relevant to aviation.



Troposphere (0–15 km):

Weather, clouds, storms, and turbulence, Temperature ↓ with altitude, wind shear, jet streams.

Tropopause: Boundary layer

Stratosphere (15–50 km): Stable air, no weather / Temperature ↑ altitude or stable / Smoother Flights

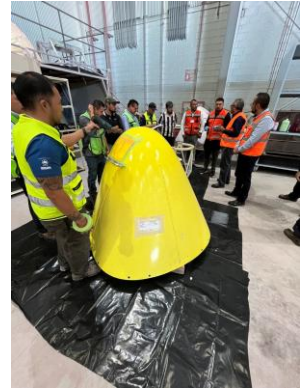
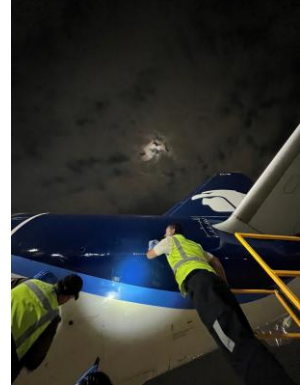
Key Aviation Challenges by Layer: Temperature & Pressure Changes / Air Density Variations / Weather & Jet Streams

Henkel Aerospace Coatings:

Protect against corrosion, thermal cycling, and pressure fluctuations / Essential for performance, durability & safety

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HENKEL AEROSPACE FIELD SUPPORT



AGENDA

HENKEL

- 01 Aerospace Structural Adhesives
- 02 Aerospace Surface Treatments
- 03 Electronics & Assembly Adhesives
- 04 Thermal Interface Materials



AEROSPACE STRUCTURAL ADHESIVES



PASTE ADHESIVE TECHNOLOGIES



Assembly Pastes

From high peel to high service temperature adhesives

Rheology and cure kinetics adapted to the applications

High reliability for durable bonding

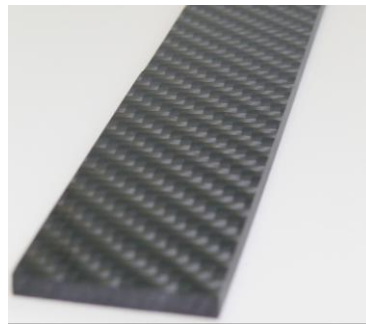


Potting Pastes

Honeycomb core filling and edge sealing

Low density combined with high compression strength

FST properties for interior applications

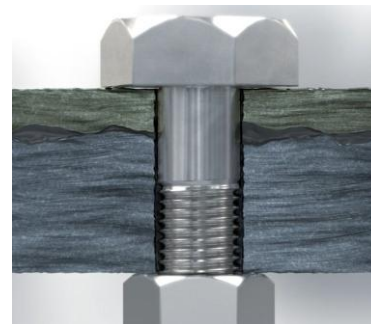


Infusion & Repair

Low viscosity adhesives for wet lay up and resin infusion

Room temperature and heat curable systems

Specialty packaging available for application flexibility



Liquid Shim

Low slump and high bond line thickness

Fast drill time and high compression strength

Adapt to automated dispensing and manual applications

PASTE ADHESIVE SOLUTIONS

PASTE ADHESIVES – LOCTITE AERO

Metal & Composite Bonding & Repair		Potting & Edge Fill	Laminate & Wet Lay-up Resins	Liquid Shim	Fire Retardant	Assembly
EA 9309NA	EA 9359.3	EA 9396.6MD	EA 9313	EA 934NA	EA 9364FR	EA 9380
EA 9309.1NA	EA 9360	EA 9820	EA 956	EA 9394	EA 9365 FST	EA 9380.05
EA 9309.2NA	EA 9392	EA 9825	EA 9390	EA 9394S	HC 3056	
EA 9363	EA 9394	HC 3056	EA 9396	EA 9377	EA 9807	
EA 9320NA	EA 9394.2	EA 9814	EA 9396/C-2		EA 9814 FST	
EA 9330	EA 9394/C-2	EA 9365FST		One Part	EA 9824 FST	Glass Beads (5 mil)
EA 9330.3	EA 9395			EA 9306NA		EA 9309.3NA
EA 9330.5	EA 9361	Service Temp. $\geq 400^{\circ}\text{F}$	Infusion Resin	EA 9820		EA 9330.5
EA 9345	EA 901NA/B-1	EA 9394/C-2	RI 9501	EA 9825	Fairing & Smoothing	EA 9359.3
EA 9321	EA 9323	EA 9396/C-2	RI 9500 Tackifier	EA 9499.4	EA 960F	EA 9394.3
				EA 9814		EA 9394.4 (10 mil)

PASTE ADHESIVE SPECIALTY PACKAGING

LOCTITE AERO

Clip Pack



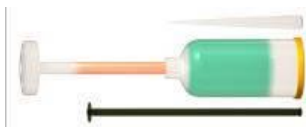
Pudding Cup



Dual Cartridge (50 ml)



Injection Kit



Barrier Kit



Dual Cartridge (200 & 400 ml)

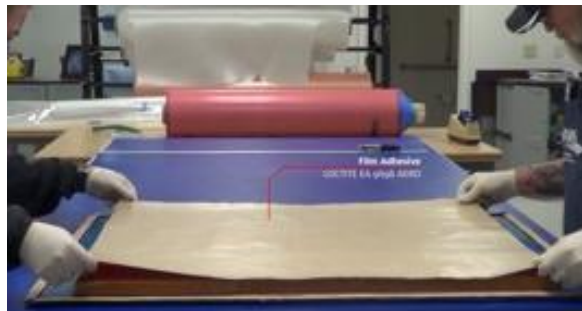
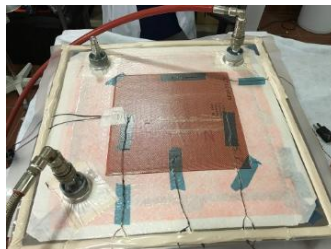


Feature

Benefit

- | | |
|---------------------------|---|
| • Equipment Mixer | • Eliminates Hand Mixing |
| • Self-contained Package | • Mixes & Dispenses Reactive Resins |
| • Pre-measured Components | • Assures Precise, Accurate, Consistent Proportions |
| • Disposable Packages | • No Messy Cleanup |
| • Extrusion | • Easy Application by Pneumatic Gun |
| • One Time Use | • Ease of Mixing |

FILM ADHESIVE TECHNOLOGIES



Structural Films

- Bonding metal, composite and honeycomb
- Large areas and complex shapes bonding
- High structural performance for primary and secondary bonding
- High reliability for durable bonding

Wet Peel Ply

- Composite surface preparation
- Enables composite parts protection
- Easy to process and highly reliable
- No dust and no clean-up process needed
- Superior bonding properties

Surfacing and LSP Films

- High quality surface finishing of composite parts
- Protection against environmental factors
- Protection against lightning strike
- Reduced surface preparation time

FILM ADHESIVE PRODUCT PORTFOLIO

Primer & Film Adhesives – LOCTITE AERO

Metal/Composite & Honeycomb Bonding	EA 9628	EA 9628H	EA 9658	EA 9673 BMI	EA 9686	
	EA 9695	EA 9696	EA 7000	EA 9690		
Composite Surface Preparation	EA 9895 WPP (177°C Cure)	EA 9896 WPP (121°C Cure)				
Bonding Primers	EA 9203 Adhesion Promoter Silane	EA 2000 Nitrile Phenolic Waterbase	EA 9258.1 Epoxy Waterbase	EA 9297NC Epoxy Waterbase (In Development)		
Surfacing & Lightning Strike Protection	EA 9837.1SF	EA 9837.1SF Black	EA 9837.1LSC	EA 9845SF	EA 9845LSC	EA 9845LSA



AEROSPACE SURFACE TREATMENTS



HENKEL PRODUCT PORTFOLIO: SURFACE TREATMENTS



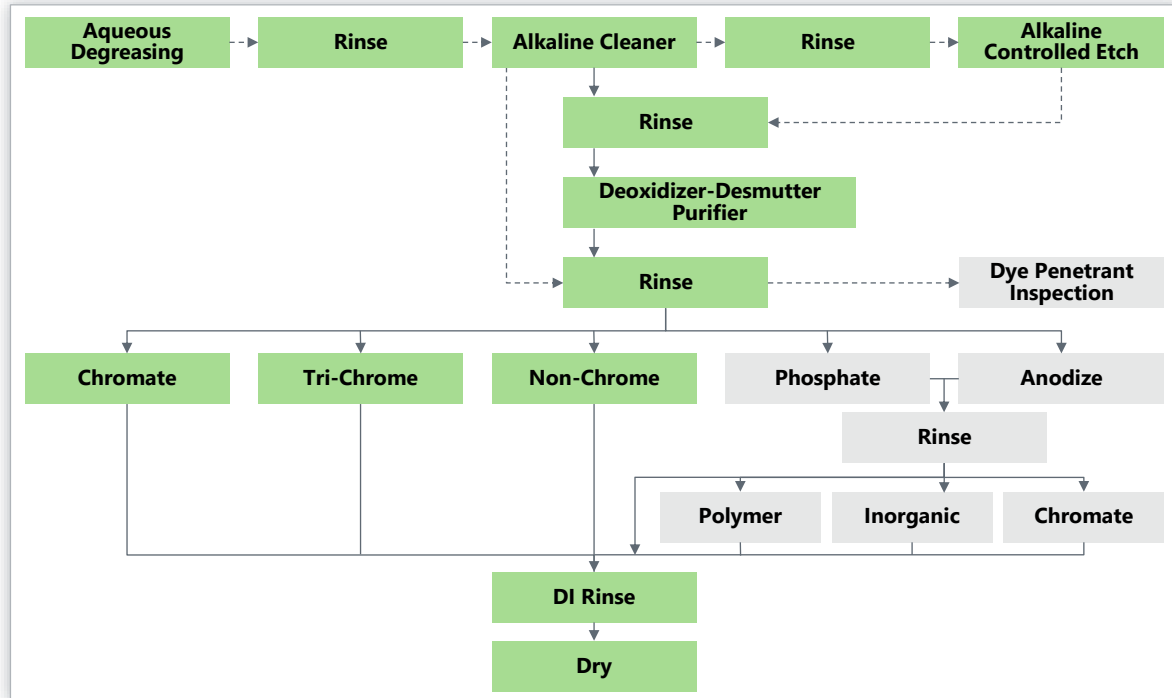
ALUMINUM CONVERSION COATINGS – TYPICAL PROCESS

Cleaning Phase

Surface Activation Phase

Surface Treatment Phase

Sealer Phase



CLEANERS



COMPARISON OF CLEANERS

	BONDERITE C-AK 4355 AERO	BONDERITE C-AK 6849 AERO	BONDERITE C-AK 298 AERO	BONDERITE C-AK SPRAY NP-LT AERO	BONDERITE C-AK 4215 NC-LT AERO	BONDERITE C-AK 4215 NC AERO	BONDERITE C-IC 33 AERO	BONDERITE C-NE C-8000GL AERO
Description	Liquid Alkaline Cleaner and/or Degreaser	Liquid Alkaline Cleaner	Liquid Alkaline Cleaner	Liquid Alkaline Cleaner	Powder Alkaline Cleaner	Powder Alkaline Cleaner	Liquid Acid Cleaner	Liquid Alkaline Cleaner, two-component
Chemical Make-Up	Phosphate-free, lightly silicated and lightly borated with surfactants	Lightly phosphated , very lightly silicated with surfactants	Non-silicated, phosphated, lightly borated with surfactants	Phosphate-free, borate-free lightly silicated with solvent and surfactants	Phosphated, borated, corrosion inhibitor, solvent, and surfactants	Phosphated, borated, corrosion inhibitor, solvent, and surfactants	Phosphoric acid, fluoride containing, water miscible solvent, surfactant	Borate and Silicate-Free cleaner, contains surfactant
Best Use	Immersion. Remove oils, grease inks, and wax based markings	Immersion. Ideal for degreasing, cleaning oils, Cosmoline and other shop soils	Immersion or exterior spray. Ideal for cleaning oils, grease, inks and wax based identification markings.	Recirculating Spray systems or immersion. Pre-cleaning prior to phosphating sequestors hard water salts	Immersion. Ideal for cleaning fuel and hydraulic components	Immersion. Ideal for cleaning fuel and hydraulic components Low Foaming at >40°C	Ideal exterior spray wash.	Immersion, can be used as standard MPT Cleaner, e.g. before Conversion Coating.
Substrate	Aluminum, zinc, titanium, and some steel with light soils.	Aluminum	Aluminum and Titanium	Ferrous, Aluminum, Titanium	Ferrous, Aluminum, Titanium, Stainless Steel	Ferrous, Aluminum, Titanium, Stainless Steel	Aluminum (not for use on copper containing alloys)	Aluminum, Steel, Titanium, Nickel and Copper based alloys

DEOXIDIZER/ DESMUTTER



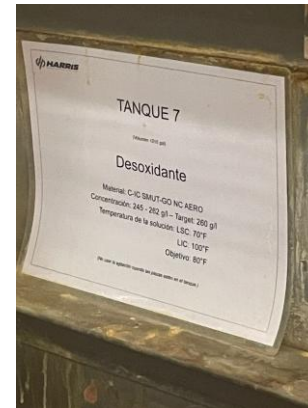
DEOXIDING & DESMUTTING

Deoxidizing vs. Desmutting

- Deoxidizing :Removes surface oxides.
- Desmutting: Removes surface deposits (Smut), without significant etching of the aluminum.

How to select a deoxidizer?

- OEM process/Specification requirements
- Alloy and surface condition
- Type of Conversion Coating being used
- Environmental concerns and regulations
- Waste disposal, safety and water conditions



COMPARISON OF DEOXIDIZERS & DESMUTTERS

	BONDERITE C-IC DEOXDZR 6MU AERO	BONDERITE C-IC 2310 AERO	BONDERITE C-IC ALDOX V AERO	BONDERITE C-IC SMUTGO NC AERO	BONDERITE C-IC HX-357	BONDERITE C-IC 4104 AERO
Description	Hexavalent Chrome Deoxidizer	Iron Based Deoxidizer	Iron Based Deoxidizer	Iron Based Deoxidizer	Non-Chrome, Non-Iron	Non-Chrome, Non-Iron
Bath Make Up	5% Turco Deox 6 10% Nitric or 5% Sulfuric	10-20% Turco Deoxalume 2310 25-30% Nitric	10-20% Turco Aldox V 20-30% Nitric	15-25% Turco Smut Go NC	2-5% Deoxidizer HX-357	Dependent on Alloy
Etch Rate	0.1-0.4 (2.5 – 10) Mils(μm)/side/hr	0.1-0.4 (2.5 – 10) Mils(μm)/side/hr	0.1-0.4 (2.5 – 10) Mils(μm)/side/hr	0.025-0.05 (0.06 – 1,5) Mils(μm)/side/hr	0.1-0.4 (2.5 – 10) Mils(μm)/side/hr	Dependent on Alloy
Acid to be Used With	Sulfuric, Nitric Acid	Nitric Acid	Nitric Acid	None	None	Nitric Acid
Temperature	Room temperature	Room temperature	Room temperature	Room temperature	Room temperature	Dependent on alloy
Application	Immersion or spray	Immersion or spray	Immersion or spray	Immersion or spray	Immersion or spray	Immersion
Typical Use	Great all purpose deoxidizer for aluminum	Good aluminum all purpose deoxidizer. Great prior to anodizing	Good aluminum all purpose deoxidizer. Great prior to anodizing	Good aluminum desmutter. Good for use before BONDERITE M-CR T 5900	Good for aluminum castings and magnesium	Great for stainless steel and titanium
Cautions	Hexavalent chrome issues	Iron can cause rinsing issues	Iron can cause rinsing issues	Iron can cause rinsing issues	Not recommended for copper alloys	Not recommended for aluminum

CONVERSION COATING



CHROMATED CONVERSION COATING PRODUCTS

Product	Form	Description
BONDERITE M-CR 1200S AERO	Powder	Product used to produce a protective coating on aluminum which minimizes corrosion and provides an improved bond for paint. Color ranges from a light iridescent golden to tan on the part.
BONDERITE M-CR 600 AERO	Powder	Product used to produce a protective coating on aluminum which minimizes corrosion and provides an improved bond for paint. Color ranges from a light iridescent golden to tan on the part. Does not contain complex cyanides.
BONDERITE M-CR 1600 AERO	Liquid	Two-package chemical used to produce a chromate conversion coating on aluminum and all its alloys. The color ranges from light iridescent gold to tan. Does not contain complex cyanides.
BONDERITE M-CR 1001 AERO	Liquid	Product used to produce a clear, protective coating on aluminum which minimizes corrosion and provides an improved bond for paint.
BONDERITE M-CR 1500 AERO	Liquid	Product used to produce a protective coating on aluminum or aluminum alloys. The coating provides protection for aluminum and is an excellent bond for clear organic coatings. It should be used when the characteristic aluminum appearance must be retained.



PAINT REMOVERS



HOW DOES A PAINT STRIPPER WORK

Mechanism:

- The paint system may dissolve and form a solution with the solvents.
- The solvent or chemical component may react chemically with the coating film and destroy it.
- The stripper may physically penetrate the coating and destroy the adhesion and cohesion of the film, thus facilitating removal.
- The stripper may penetrate the film through scratches, pinholes, broken edges, etc., and destroy the adhesion to the substrate.



PAINT STRIPPER TYPES

Regulated

Methylene Chloride

- Fast stripping times
- Safe on a majority of substrates
- **S-ST 5351**
- **S-ST 5351 THIN**



Environmentally Advantaged (EA)

Acid Activated

- Fast stripping times
- Can be used on a majority of substrates
- **S-ST 6776-LO**
- **S-ST 6776 THIN**



Peroxide Activated

- Medium stripping times
- Can be used on a majority of substrates
- **S-ST 6930**



Alkaline Activated

- Slow stripping times
- Safe on a majority of substrates
- **S-ST 6813E**
- **S-ST 1270-6**



Time required to strip a part

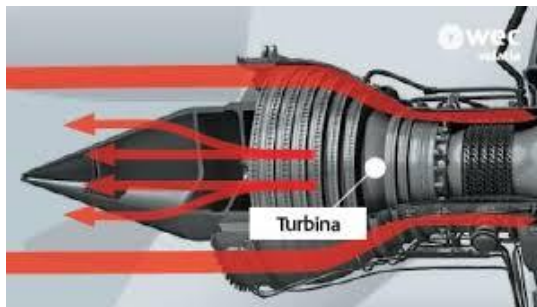
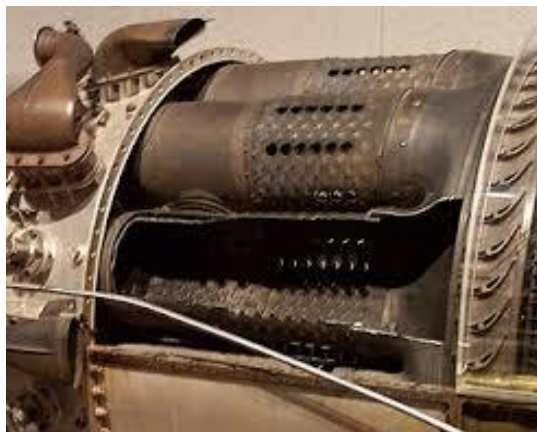
Degree of attack on substrate.

ENGINE OVERHAUL

ENGINE OVERHAUL CHEMICALS CLEANERS

What are we cleaning?

Primarily metal oxide scales, sulfadation byproducts and carbonaceous material.....



Why do we clean engine parts?

1) Component / engine inspection - certification

Proper cleaning allows for rapid and efficient detection of surface defects.

2) Improve engine efficiencies

Scale, soil and dirt build-up reduces fuel efficiency of jet engine. With fuel costs escalating, maintaining clean engines reduces operating costs

3) Chemical cleaning methods are preferred

Physical abrasion or shot blasting may block detection of defects during NDT.

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ENGINE OVERHAUL PRODUCTS

Process Step	Product	Description
Pre-Cleaner	BONDERITE C-AK 5948 DPM AERO	Water base compound formulated to clean painted and unpainted aircraft exterior and interior surfaces when diluted with water. Immersion and spray application.
Alkaline Rust Remover	BONDERITE C-AK 4181GL AERO	Alkaline degreaser formulated to remove rust, paints, lube oils, drawing pastes, cutting oils and protective oils from ferrous alloys.
Scale Conditioner	BONDERITE C-IC SCALEGON 5 AERO	They are used to condition and remove high temperature scale from jet engine parts. This process is designed to facilitate non-destructive testing (penetrant) and reconditioning of parts.
Alkaline Permanganate	BONDERITE C-AK 4338L AERO	2-part liquid alkaline permanganate formulation which modifies high temperature heat scale ease of chemical removal in subsequent processing steps.
Inhibited Phosphoric Acid	BONDERITE C-IC 4409GL AERO	Clear, colorless liquid acid cleaner and deoxidizer designed for use on ferrous and nonferrous alloys by immersion, spray and hand wipe methods.

