

The science of aircraft belly protection

French Air and Space Force mitigates FOD damage and reduces repair costs with aircraft belly tape.

Many aircraft, especially those operating from rough landing strips, incur foreign object debris (FOD) damage to the fuselage, sponsons and other underside components. This article explores how the French Air and Space Force collaborated with 3M to achieve rugged aircraft underside protection and guard against FOD damage.

Aircraft foreign object damage

The Airbus A400M Atlas is a military transport aircraft used for heavy cargo transport.

Because the A400M frequently operates from rough or unpaved landing strips, its underside, or belly, can incur significant and extremely expensive foreign object debris (FOD) damage. The metallic fuselage, composite sponsons and other surfaces can be damaged by debris such as rock and grit projectiles kicked up during takeoff and landing. This can require heavy maintenance operations, costly part replacements and a long aircraft-on-ground (AOG) time to repair.



The A440M landing on an unpaved landing strip. Image courtesy of Sergent-Chef Marzin Loic, ©L.Marzin/Armée de l'Air. Reproduced with permission.

FOD protection with aircraft belly tape

To guard against FOD, control A400M repair costs and shorten AOG times, the French Air and Space Force (Armée de l'air et de l'espace, hereafter French Air Force) sought a durable protective solution for aircraft undersides. The French Air Force selected 3M™ Polyurethane Protective Tape 8642 for its ability to provide robust impact resistance to the aircraft belly. The protective tape was applied to the A400M fuselage and sponsons to help prevent damage caused by small FOD impacts.

After two years of service, the protective tape was removed from the A400M and the aircraft undersides were inspected. While unprotected fuselage and sponson areas exhibited significant FOD damage, protected areas displayed little or no damage.



Impact damage on unprotected area. Image courtesy of Sergent-Chef Marzin Loic, ©L.Marzin/Armée de l'Air. Reproduced with permission.



Impact on area protected by 3M Tape 8642 without perforation. Image courtesy of Sergent-Chef Marzin Loic, ©L.Marzin/Armée de l'Air. Reproduced with permission.

Hear from the customer

“Three years after the Airbus A400M entry into service in 2013, the French Air Force Operational Test and Evaluation Team began its unpaved runway operation experiments,” said Adjutant-chef (OR-9) Jean-Christophe. “The conclusions were obvious: the aircraft belly must be protected to preserve fuselage integrity.

“The 3M solution came as a matter of course. 3M Tape 8642 helped protect the aircraft skin and could be replaced at will. Normally, skin is repaired by abrading the surface; however, abrading decreases skin thickness as more repairs are carried out. The 3M solution helped significantly reduce the need for abrading and enabled us to maintain aircraft skin integrity.

“It’s been almost six years and more than 300 total landings on unpaved runways that the French Air Force fleet of A400M has been equipped with 3M Tape 8642, and results are more than satisfactory: structural damage to the protected areas has been negligible. Maintenance time is considerably reduced, and structural aging is slowed down.

“The French Air Force is proud of this partnership with 3M. The joint work on this innovative project has paid off and aroused the interest of other national armed forces using the A400M.”

— Adjutant-chef (OR-9) Jean-Christophe
Operational Test and Evaluation Team, French Air and Space Force

Advantages over legacy product

3M™ Polyurethane Protective Tape 8642 offers key advantages over the legacy product 3M™ Polyurethane Protective Tape 8641.

3M Tape 8642 provides surface protection equivalent to 3M Tape 8641 while also enabling improved removability and repositionability during and after installation. 3M Tape 8642 also has a lower peel force and can be removed without paint strippers.

Efficient removal to help minimize ground time

In addition to FOD protection, the ability to efficiently remove the tape every two years was cited by the French Air Force as a key requirement. Belly tape is removed from the A400M and replaced every two years on average, often requiring substantial AOG time. Enhancing removal process efficiency is crucial towards minimizing AOG and maximizing overall cost effectiveness.

When first implemented, removing 3M Tape 8642 from the A400M belly took 12-15 operators a week or longer to complete. On average, 480 man-hours were needed. To address this issue, the 3M Aerospace team devised a steam-assisted removal method that helped dramatically shorten removal time. With this method, five operators removed the tape from the aircraft belly in just three days. In total, 120 man-hours were needed — 75% shorter than when first implemented.

When using the steam-assisted method, 3M Tape 8642 could be efficiently removed from the A400M underside while leaving minimal residue. Aircraft skin temperature was less than 60 °C, and no cutting or paint strippers were needed.

Qualification

3M partnered directly with the French Air Force during the qualification process. All qualifications for this product on the A400M were made by the Direction générale de l'armement (DGA).

Additional product details

3M™ Polyurethane Protective Tape 8642 is a rugged impact protection aircraft belly tape that can help guard aircraft surfaces such as lower fuselage, sponsons, flaps and spoilers against small foreign object damage and erosion.

The tape combines a tough polyurethane outer layer with an energy-absorbing acrylic foam core. A removable liner protects the tape during storage. Perforated and non-perforated versions are available.

For more details, see the [technical data sheet](#).

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3M Automotive and Aerospace Solutions Division

3M Center
St. Paul, MN 55144 USA

Phone 1-800-328-1684
Web www.3M.com/aerospace

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