FLUOROCARBON

CASE STUDY

REDUCING RESIN ADHESION IN HIGH-PRECISION ADDITIVE MANUFACTURING SYSTEMS

OVERVIEW

In industrial additive manufacturing, consistency during material deposition is vital. A manufacturer of advanced 3D printing systems identified a limitation in a key process component: a blade used to spread high-viscosity photopolymer resin during layer-by-layer fabrication.

The existing anodised aluminium surface offered durability but lacked control over resin interaction. At viscosities up to 3,000 cP, the resin adhered to the blade surface, increasing drag and causing uneven material distribution.
The challenge was not simply to apply a non-stick coating but to engineer a surface capable of actively managing fluid behaviour while maintaining mechanical integrity and process stability.

THE ENGINEERING CHALLENGE

Instead of focusing solely on coating type, the challenge was reframed around surface–fluid interaction. The blade needed to minimise viscous drag by reducing resin adhesion while promoting controlled flow and easy release during movement. Simultaneously, the solution had to sustain durability under repeated mechanical contact and resist exposure to epoxy resins, acrylates, and cleaning solvents. These requirements had to be met without compromising tight dimensional tolerances around 30 µm, adding further complexity to the design constraints.

This set of requirements introduced competing constraints. Lower surface energy improves release but may reduce wear resistance, whereas harder coatings could increase interaction with the resin. The engineering challenge was therefore to balance these conflicting characteristics without sacrificing overall system performance.

OUR APPROACH

The approach focused on balancing these trade-offs through careful material and process selection.

Fluoropolymer-based coatings emerged as promising candidates due to their inherently low surface energy and chemical inertness. However, their selection was not based solely on material properties. The coating system had to be engineered to ensure:

- Stable hydrophobic performance (target contact angle >120°)
- Resistance to abrasion and scratching through repeated cycles
- Chemical compatibility without contamination or off gassing
- Uniform application across complex geometries

At this stage, optimisation became essential, aligning surface chemistry with mechanical performance and manufacturing constraints.

VALIDATION THROUGH APPLICATION-LED TESTING

To overcome the combined load and installation constraints, Fluorocarbon delivered a hybrid bearing assembly consisting of a Fluorinoid® FL830 material pad fastened to a steel backing plate. The backing plate ensured flatness across the bearing surface and was supplied in multiple sizes to suit the application.

A purpose-made non-standard counter surface was also specified to further reduce friction performance under high load conditions. After installation and verification, the steel backing plate was welded directly into the existing structure, eliminating the need for structural modification.

Performance validation was completed using EN 10204 3.1 testing, including both compressive and friction testing. Compressive testing demonstrated a repeatable stress–deformation response across the sheet, with Fluorinoid® FL830 comfortably exceeding the 85MPa compressive load requirement while maintaining very low strain.

Compared with traditional PTFE bearing compounds, FL830 delivered significantly higher compressive strength and rigidity, making it suitable for demanding high-load applications.

Stress-strain behaviour of traditional PTFE bearing compounds (FL129) against new high pressure bearing material (FL830) was compared. As shown, FL830 delivers exceptionally high compressive strength (~above 100MPa) at very low strain (<1%), far exceeding traditional PTFE materials. FL830 Clearly outperforms FL129 in strength, rigidity, and structural support, making it ideal for demanding, high-load applications.

Friction testing demonstrated a low and stable coefficient of friction under 90MPa specific load, with minimal variation over repeated cycles and negligible wear, indicating predictable long-term sliding performance against stainless steel.

THE OUTCOME

The outcome was a technically feasible coating strategy designed to reduce resin carryover, improve flow behaviour, and maintain surface durability in a demanding application.

More importantly, the project demonstrated a broader engineering principle: performance in coating systems is defined at the interface. Success depends not on choosing a “non-stick” material, but on understanding and controlling how surfaces interact with real-world media under operational conditions.

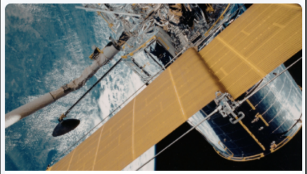
WHY FLUOROCARBON

Fluorocarbon combines deep fluoropolymer expertise with an engineering-led approach to problem-solving. This project demonstrated Fluorocarbon’s ability to support complex, high-load applications where standard PTFE solutions are insufficient.

By focusing on application understanding, validated performance, and long-term reliability, Fluorocarbon helped the customer develop a safe and effective solution while reducing both technical and commercial risk.

The project also demonstrated Fluorocarbon’s capability to integrate engineered fluoropolymer solutions within existing infrastructure constraints while maintaining clear communication and responsive technical support throughout the project lifecycle.

ADDITIONAL COATINGS CASE STUDIES



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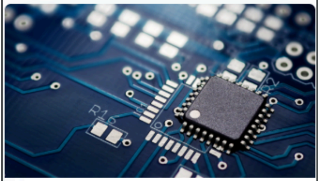

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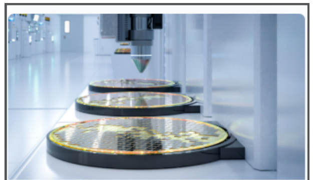

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