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# SEALED FOR SPEED:

The Greene Tweed  
MSE<sup>®</sup> Seal Behind  
McLaren Mastercard  
Formula 1<sup>®</sup> Team's  
Differential

A behind-the-scenes look at how  
teamwork, innovation, and precision  
engineering shaped a winning solution.





“Given Greene Tweed’s longstanding reputation for excellent quality, choosing them was an obvious choice for us. The MSE Seal has consistently demonstrated its durability and reliability within our system. We’re confident this is just the beginning of a long-term collaboration to drive even greater performance in future seasons.”

**James Manning**, Head of Transmission, McLaren Mastercard Formula 1® Team

**McLaren Mastercard Formula 1® Team** has built its long-standing legacy in motorsports on precision engineering, innovation, and a constant drive for improvement. Drawing on more than six decades in elite racing, McLaren focuses relentlessly on marginal gains, recognizing that improvements in each and every component can deliver meaningful competitive advantages on the track.

It is this pursuit of optimal performance that led McLaren to partner with **Greene Tweed**, seeking a proven expert in advanced sealing solutions for their limited-slip differential clutch pack, a critical system in its race cars that optimizes torque distribution between the wheels for maximum traction and cornering speed.

**Through close collaboration with McLaren, Greene Tweed designed and delivered two Metal-Spring-Energized (MSE®) seal assemblies made from their proprietary Avalon® material, which were used in both Formula 1® cars during the 2022-2025 seasons.**

The sealing solutions provide the extreme temperature resistance, chemical compatibility, and robust sealing integrity necessary for the demanding system application. The result was a significant enhancement in component reliability and performance.



### The Challenge: Sealing the Actuator for Limited-Slip Differential Control

The limited-slip differential clutch pack uses a hydraulic actuator for control, which requires an exceptionally robust sealing solution. The actuator clamps a friction clutch inside the differential, limiting wheel speed difference across the rear axle. It redirects torque to the wheel on the side of the car with more available grip, enabling the car to make the most of the power available.

**The integrity of this seal is critical; any significant leakage would cause a catastrophic loss of system function, forcing the car to be retired.**

Thus, presenting an intense operating environment characterized by:

**Elevated Temperatures:** The system operates at temperatures up to 150°C (302°F), requiring seals capable of withstanding intense heat.

**Aggressive Fluids:** Given the system application, seals need to maintain integrity while interacting with corrosive fluids.

**High System Pressure:** The actuator operates pressures from 5–250bar (72.5–3625psi), demanding a seal with high compressive strength.

**Extended Operation:** The components must perform for intense racing conditions, requiring a high resistance to degradation and wear.

Successfully addressing these challenging operational parameters is crucial for maximizing the reliability and longevity of the differential’s hydraulic actuator.

### The Solution: Collaborative Engineering and Advanced Materials

Through detailed analysis and consultation, Greene Tweed identified its Metal-Spring-Energized (MSE®) seal as the ideal solution. The MSE® seal is designed for superior dynamic performance in applications with extreme temperatures, high pressures, and demanding chemical environments.

**The solution included two key elements:**

**MSE® Seal Design:** The unique C-shaped profile of the MSE® jacket, combined with a mating corrosion-resistant metal spring, provides a constant, uniform sealing force. This design enables leak-free performance even with thermal cycling and pressure spikes.

**Avalon® (PTFE):** This advanced, proprietary PTFE material was selected for its unique combination of properties. Avalon® 44 offers superior wear resistance and high strength, ensuring the seal maintains its shape and function under immense pressure. Its low creep relaxation and low-friction characteristics were vital for consistent, efficient actuator performance over the life of the component.

Following rigorous testing on a dynamic transmission test rig, Greene Tweed’s engineering team in close collaboration with McLaren’s engineers has since successfully qualified the next generation MSE® sealing system.

This more robust version of the original MSE® seal, reinforced with backup ring support, Avalon® 44 jacket, and a finger spring, has supported McLaren’s development of a more compact version of their system — a breakthrough that means these innovative seals will be ready for deployment on the 2026 cars.



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# Why MSE® Seals

## The Results: Reliable Performance When It's Needed Most

Greene Tweed's MSE® Seal Assemblies successfully addressed the initial challenges of temperature, pressure, and chemical exposure, leading to a marked improvement in system reliability and endurance life. By providing a leak-free, durable sealing solution, Greene Tweed has helped ensure system integrity, directly contributing to McLaren's ability to compete at the highest level without fear of mechanical failure in this critical area.

The original seal solution has been a core part of the on-car system since the 2022 season, and the upgraded seal assembly is confirmed for use in the 2026 system, a testament to its proven reliability and performance.

- Temperature rated up to 550°F (288°C)
- Pressure rated up to 10,000 psi (689 bar)
- Can run dry or lubricated
- Low friction for smooth and consistent breakout
- Unlimited shelf life
- Chemically inert for virtually unlimited chemical compatibility
- A range of spring geometries and seal materials exist, allowing performance to be optimized regardless of system operating conditions.

## Conclusion: Partnership Driven Innovation

The successful collaboration between McLaren's and Greene Tweed's engineering teams, highlights the essential role advanced sealing systems play in high-stakes environments where failure is not an option.

This same level of reliability and precision is vital in critical applications across industries such as aircraft engines and landing gear, energy systems' fuel controls, pumps, and valves, and semiconductor manufacturing etch chambers.

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