March 17, 2003: 2004 Cadillac XLR - Advanced Structure and Chassis Create Remarkable Blend of Luxury and Performance

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Cadillac XLR - Advanced Structure and Chassis Create Remarkable Blend of Luxury and Performance

Underneath the surface, the 2004 Cadillac XLR has a foundation of technology that matches its striking exterior style. Never before has a GM production vehicle cast such a sophisticated shadow as the XLR, which begins appearing at Cadillac dealerships this summer. The car's remarkable body structure and chassis make the XLR a luxury roadster with genuine performance car roots.

The story starts with the XLR's backbone, upon which the car's dynamic capabilities depend. Based on the next generation of GM's performance car architecture, this unique and patented structure comprises steel hydroformed perimeter frame rails, enclosed structural "tunnel," aluminum cockpit structure and balsa-cored composite floors. Providing rigidity without bulk, and with exceptional resistance to torsional and bending forces, this

architecture is the basis for the XLR's outstanding ride and handling characteristics.

"The patented performance car architecture is designed specifically for an open car, and creates the ideal foundation for the blend of luxury and performance attributes of the XLR," said David Hill, vehicle line executive for GM's Performance Cars.

XLR - lightweight and balanced

Advanced materials were carefully selected for the XLR's precise mission as a luxury roadster. Extensive use of aluminum in suspension control arms and cross members, magnesium components in the body and folding top structures, plus advanced composite body materials contribute to the XLR's overall weight being the lowest in its class. Compared to the Mercedes-Benz SL500, Jaguar XK8 and Lexus SC430, the XLR is not only the lightest vehicle at approximately 3,650 lbs., but it also boasts the longest wheelbase, widest track, lowest height and most horsepower.

Another advantage of Cadillac's roadster not shared by the competition is its rear-mounted transmission. This helps give the XLR a virtually 50/50 front-to-rear weight distribution for superior balance, as well as providing occupants unusually roomy footwell space.

Outstanding agility

Taken together these factors establish the foundation for excellent dynamic stability and responsiveness, said Dave Leone, XLR chief engineer. "The combination of a stiff body structure with low weight and excellent balance sets the stage perfectly for outstanding agility."

Compared to most convertible cars, the XLR will feel more rigid and solid, regardless of the whether the top is up or down.

Building on XLR's solid structural foundation, Cadillac engineers added several technologically advanced chassis features, including StabiliTrak active

handling, Magnetic Ride Control and Magnasteer. "A high-speed data network in the car allows these electronic systems to share information and work together as an integrated system," said Leone. "The effect on the driver is a car that is smooth and well-controlled, yet maintains excellent 'feel' and responsiveness."

A luxury roadster with performance car roots

The objective of the suspension system is to make the XLR a true luxury roadster with the handling qualities of a performance car. To this end, the design utilizes double wishbones at each corner, combined with transverse-mounted, composite leaf springs front and rear. The system is designed to maintain firm control over wheel motion, while delivering a composed and compliant ride quality. During normal driving, the chassis exhibits comfortable and confident handling characteristics; when pushed harder, the car remains stable and secure with outstanding road holding. The XLR achieves a maximum lateral G-force of over 0.9.

The XLR employs one of the most sophisticated and integrated electronic chassis control systems in the industry. However, unlike some rival systems, which can interfere aggressively with control of the car, the XLR's chassis control system is developed to be as unobtrusive and transparent as possible to the driver.

Four-channel StabiliTrak system

At the core of the XLR's active handling is StabiliTrak, a highly integrated four-channel system that can control all four corners of the vehicle. The system acts instantaneously to reduce the likelihood of loss of control by enhancing vehicle stability and directional control when the car approaches its limits. StabiliTrak analyzes input from a series of sensors and then applies braking force at the relevant wheel or wheels in order to turn the car in the direction intended by the driver.

StabiliTrak also integrates the XLR's anti-lock brake system, traction control system, powertrain and Magnetic Ride Control system in order to manage the

car’s handling.

Magnetic Ride Control - World’s fastest reacting suspension
The XLR is one of the world’s first vehicles equipped with Magnetic Ride Control - electronically controlled, magnetic-fluid based real-time damping. The system uses four wheel-to-body displacement sensors to measure wheel motion over the road surface and responds by adjusting the shock damping at speeds approaching one millisecond. That’s five times faster than previous "real time" damping systems.

The secret behind Magnetic Ride Control is the magneto-rheological fluid contained in its dampers, replacing traditional mechanical valves. Suspended in this fluid are tiny iron particles that respond to an electromagnetic charge.

In the presence of a charge, the iron particles align themselves into fibrous structures that almost instantaneously create precise and wide-ranging damping characteristics. With sensors reading the road surface at a rate of 1 inch at 60 mph, the system responds by commanding constant changes in damping force at all four corners. The goal is to maintain tire contact with the road surface and to keep the body on an even plane, with smooth, well-controlled body motions even during aggressive maneuvers or on uneven road surfaces.

In relation to active handling, the Magnetic Ride controller will activate if needed to help respond to weight transfer, or roll gradient, of the vehicle - for example during braking, it may stiffen the damping rate in one or more corners to maintain smooth body motions.

A key enabler for the effectiveness of the XLR’s various electronic control systems is a local area network (LAN) high-speed communication bus. This links StabiliTrak, Magnetic Ride Control, ABS, traction control and powertrain control and allows the instantaneous interaction necessary for successful operation.

To ensure the XLR exhibits precise, responsive steering, Cadillac has adopted Magnasteer, a speed-variable power-assisted system, combining conventional hydraulics with patented electro-magnetic control technology. Steering effort is applied via magnetized "doughnuts" mounted around the output shaft, which stiffen the rate as vehicle speed increases. The system is tuned to begin subtly increasing effort after about 40 miles per hour. This allows for effortless low-speed maneuverability for parking and increased control at high speeds.

XLR with extended mobility tires

The XLR runs on Michelin ZP tires with advanced "run flat" technology that eliminates the need for a spare and provides outstanding overall tire performance. The ZP design has self-supporting sidewalls that allow the tires to maintain safe function during and after a loss of pressure for up to 125 miles of continuous driving. The ZP technology has been specifically tuned for the XLR, and features overall performance superior to many competing run-flat systems, which are designed strictly for high performance use and exhibit harsh ride qualities.

The wheels include a pressure monitoring system that transmits pressure within one pound per square inch from each tire to the driver information center, alerting the driver if there has been a loss of pressure.

Cadillac XLR key structural features:

- **Hydroformed perimeter frame rails:** Created from steel tubes, the XLR's 170-inch rails are the longest hydraulically formed sections in passenger car use. With no seams, joints, welds or overlaps, the rails are extremely rigid yet have low mass. In a conventional convertible, necessary structural reinforcements add considerable weight and bulk.
- **Center tunnel:** Acting as structural backbone, the center tunnel is a tall, enclosed rectangular passage through which the driveshaft passes. The tunnel runs from the front to rear axle and resists longitudinal twisting motion in the car's body.
- **Cored composite floors:** This unique design employs balsa wood

material sandwiched between strong composite floor panels. These lightweight floors not only support the cockpit area, but they also underpin the trunk area, providing an added measure of insulation from unwanted sound and vibration.

- **Aluminum and magnesium components:** Strong, lightweight one-piece cast aluminum chassis cross members machined to precise dimensional tolerances for accurate suspension geometry. All-aluminum double wishbone suspension and lightweight tubular stabilizer bar. Die cast magnesium folding roof structure, steering column support, ABS controller. Cast spun aluminum high-performance wheels.

Key chassis features:

- **StabiliTrak:** State-of-the-art active handling system with the highest level of integration between the braking, traction control, steering and suspension systems. StabiliTrak can help the XLR driver control the car, without "over-governing."
- **Magnetic Ride Control:** Suspension system that uses magneto-rheological real-time damping to provide exceptional responsiveness and increased wheel contact with the road surface. The system reads the road, and acts on each suspension corner to keep the body level with smooth, well-controlled body motions.
- **Magnasteer:** Variable-effort steering affords drivers unparalleled control on the highway and effortless low-speed maneuverability for parking in an exceptionally smooth power steering system.
- **Anti-lock braking system (ABS):** Four-channel system includes dynamic electronic brake distribution across the rear axle for optimum braking and control under the most demanding conditions.
- **Four-wheel disc brakes:** The large rotors (325 mm front, 305 mm rear) and aluminum sliding calipers provide world-class reliability, durability and performance. Premium non-metallic brake pad material delivers superior consistent, quiet performance under all conditions.

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