

**CHEVROLET**



# WELCOME

Terry Rhadigan  
GM Communications

# HOUSEKEEPING



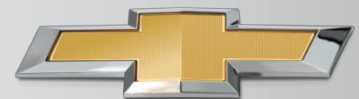
**Nürburgring video and press release will be live at 9 AM**

**Information, impressions and photos are embargoed until 10/16 at 12:01 AM EDT**

**Photographer available (AJ Mueller)**

**USB with press materials, including**

- GoPro video of your track hotlaps
- Presentation
- Supplier press releases



# AL OPPENHEISER

*Chief Engineer*



Pre-production model shown



# NÜRBURGRING



**Accumulated 10 hours on-track testing**

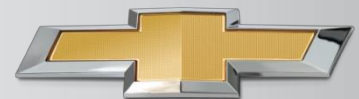
- 1,000 miles on the Ring
- Each lap under 8 minutes

**Fastest lap on video was a 7:37.40, in the rain**

- 4 seconds faster than the Camaro ZL1
- Faster than published times for Porsche 911 Carrera S, Lamborghini Murcielago



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The background of the image is a blurred photograph of a race track. A car is visible in the lower right corner, its wheels and body blurred due to motion. The track has a red and white striped curb on the left side. In the background, there are dense evergreen trees under a cloudy sky. Overlaid on this image is large, bold, white text.

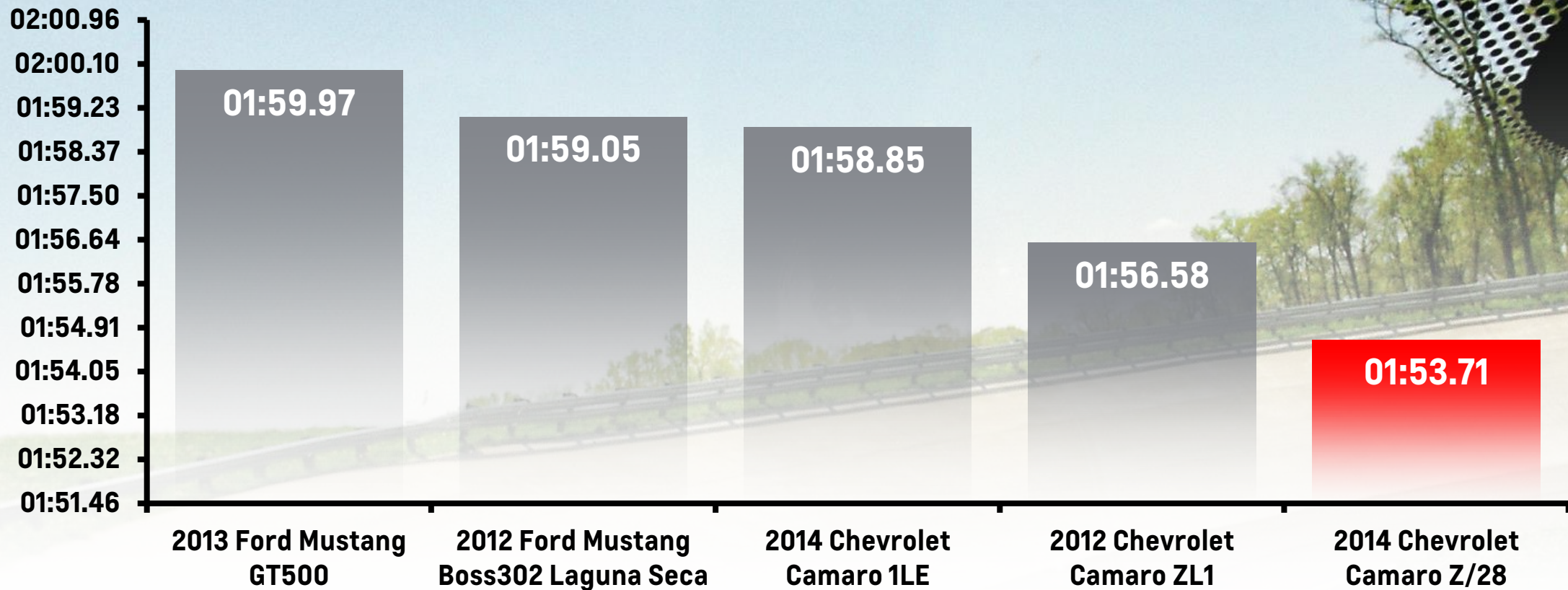
# THE ALL-NEW 2014 CAMARO Z28



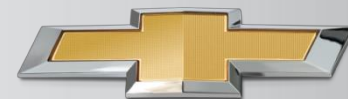
# MILFORD ROAD COURSE



Lap Times



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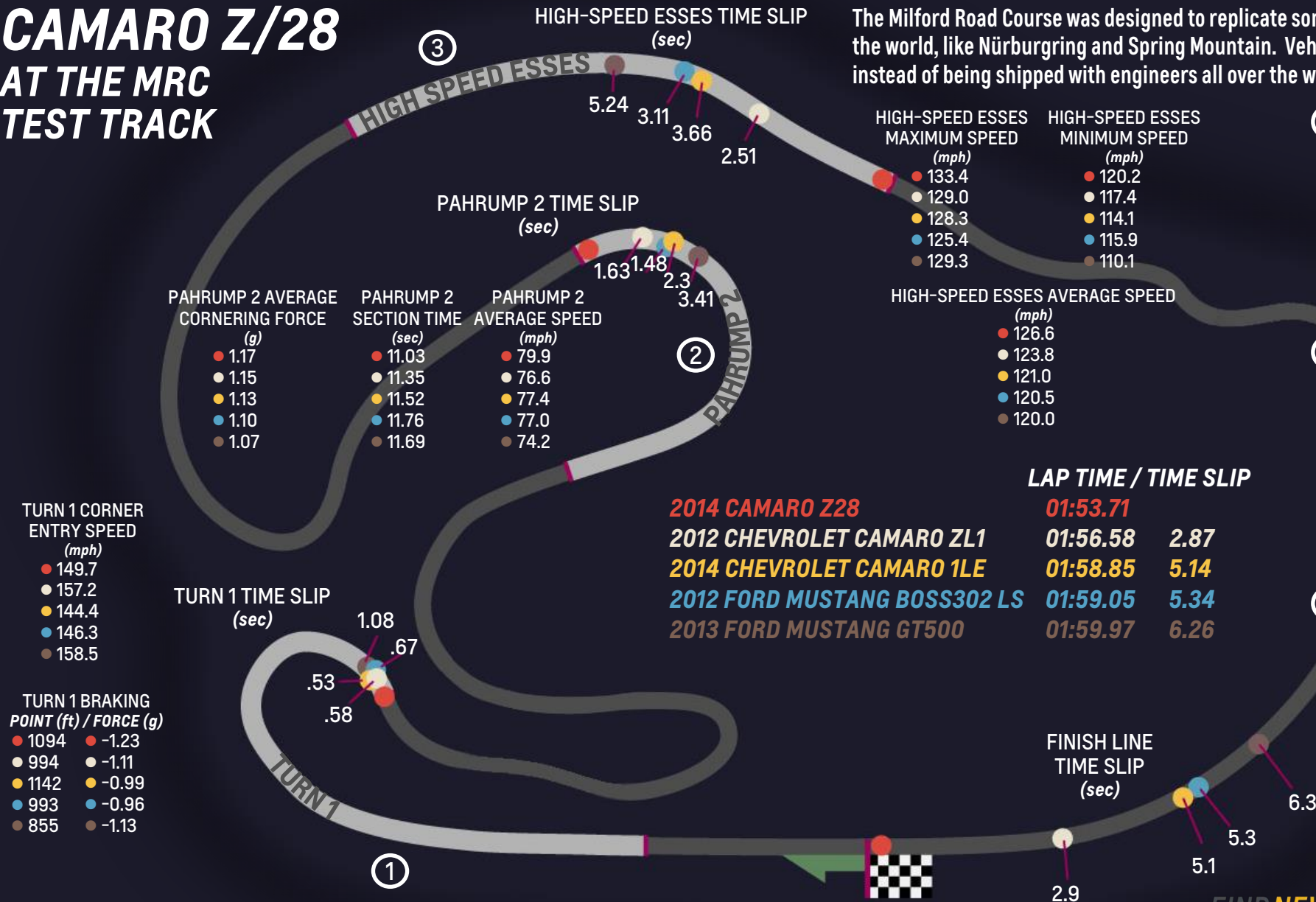


# CAMARO Z/28

## AT THE MRC

### TEST TRACK

The Milford Road Course was designed to replicate some of the best tracks around the world, like Nürburgring and Spring Mountain. Vehicles can be tested locally instead of being shipped with engineers all over the world, saving both time and money.



**① TURN 1:**  
A downhill, decreasing radius turn. The high-horsepower ZL1 and GT500 have higher entry speeds; however the Z/28 is able to brake 238 feet later (100ft later than a ZL1 and the Boss302 LS); and reaches higher peak braking force. By the end of turn one, the Z/28 is ahead of all cars.

**② PAHRUMP 2:**  
Long, technical turn with banked exit that increases cornering forces to as high as 1.5 g – testing the vehicle's handling and engine-oiling system. The grip of the Z/28 is evident in the peak cornering force, average speed and section time. The Z/28 gains a full 0.7 seconds over the Boss302 LS in this section alone.

**③ HIGH-SPEED ESSES:**  
Emulating the Nürburgring, the High-speed Esses test high-speed stability. The aerodynamic downforce of the Z/28 allows it to carry more speed through Esses. The Z/28 enters the corner 4 mph faster than the GT500 (with less overall power) and achieves a 10 mph faster minimum corner speed.

#### 2014 CAMARO Z28

2012 CHEVROLET CAMARO ZL1

2014 CHEVROLET CAMARO 1LE

2012 FORD MUSTANG BOSS302 LS

2013 FORD MUSTANG GT500

#### LAP TIME / TIME SLIP

01:53.71

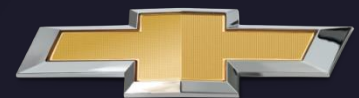
01:56.58 2.87

01:58.85 5.14

01:59.05 5.34

01:59.97 6.26

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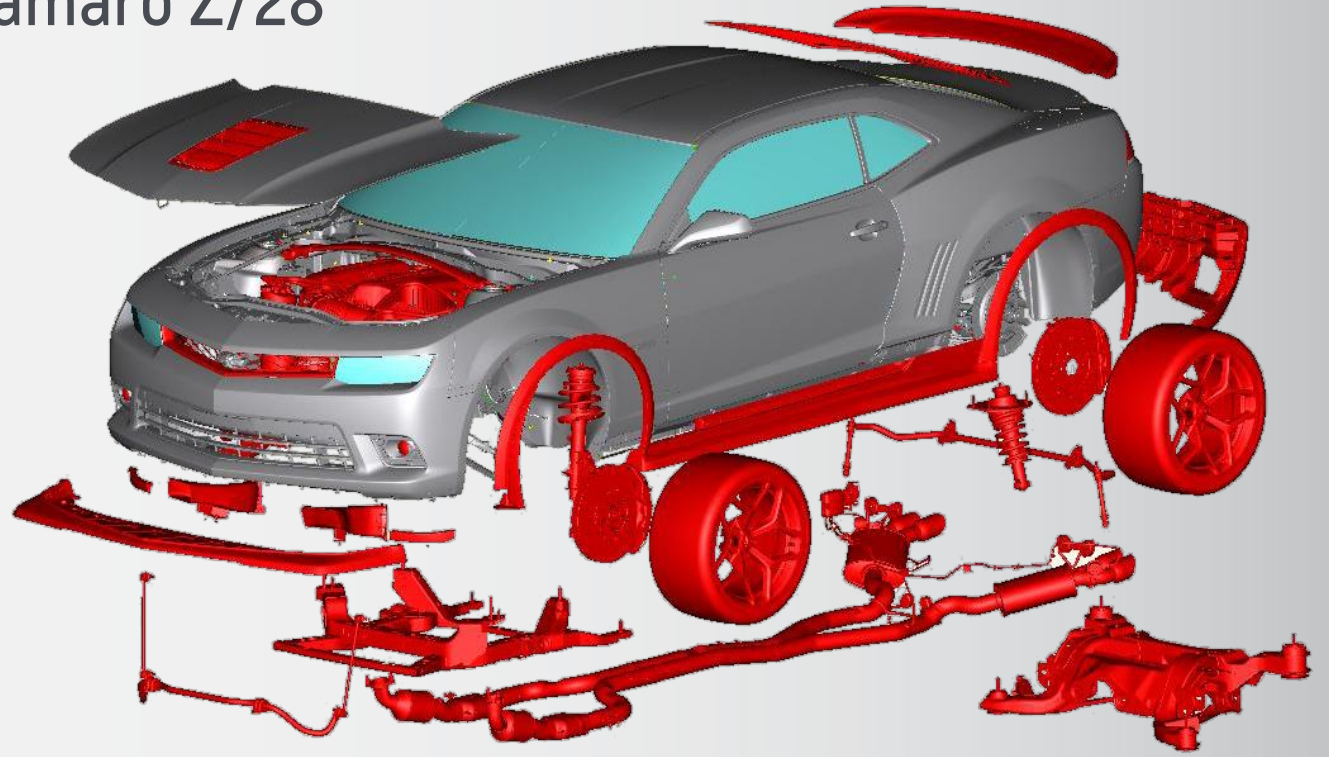
# ***Z/28 VS BOSS 302 @ MRC***



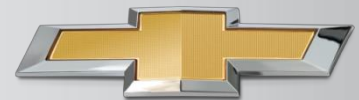
# MOST TRACK-CAPABLE CAMARO, EVER



- More than 190 parts are unique from the 2014 Camaro 1SS to the Camaro Z/28
- Each change focused on lapping a road-course as fast as possible
- Some of the best names in Performance including: Brembo, Pirelli, Recaro, Torsen, Pankl and Multimatic



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# THREE SOURCES OF IMPROVED LAP TIMES



## 1. *Lightweighting:*

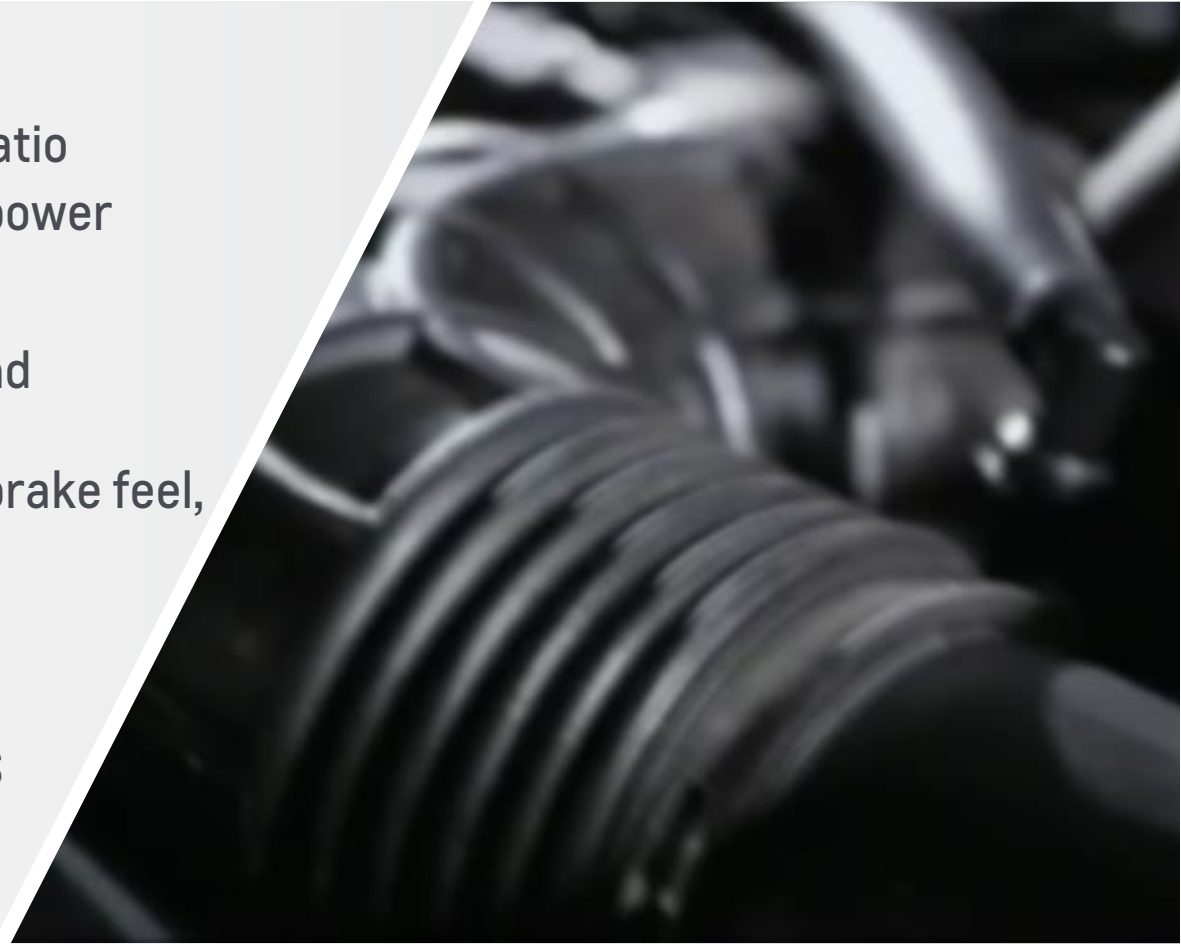
- 3,837 pounds, for a 7.59 pounds / horsepower ratio
- Naturally-aspirated LS7 engine with 505 horsepower

## 2. *Increased braking performance:*

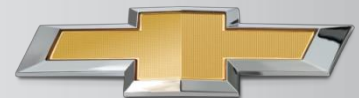
- Standard Brembo Ceramic Composite brakes and 305/30ZR19 Pirelli Trofeo R tires
- Capable of 1.5 g in deceleration and consistent brake feel, lap after lap

## 3. *Increased grip:*

- Up to 1.08 g in cornering acceleration
- 33mm lower center of gravity than a Camaro SS
- Comprehensive chassis and aerodynamic modifications



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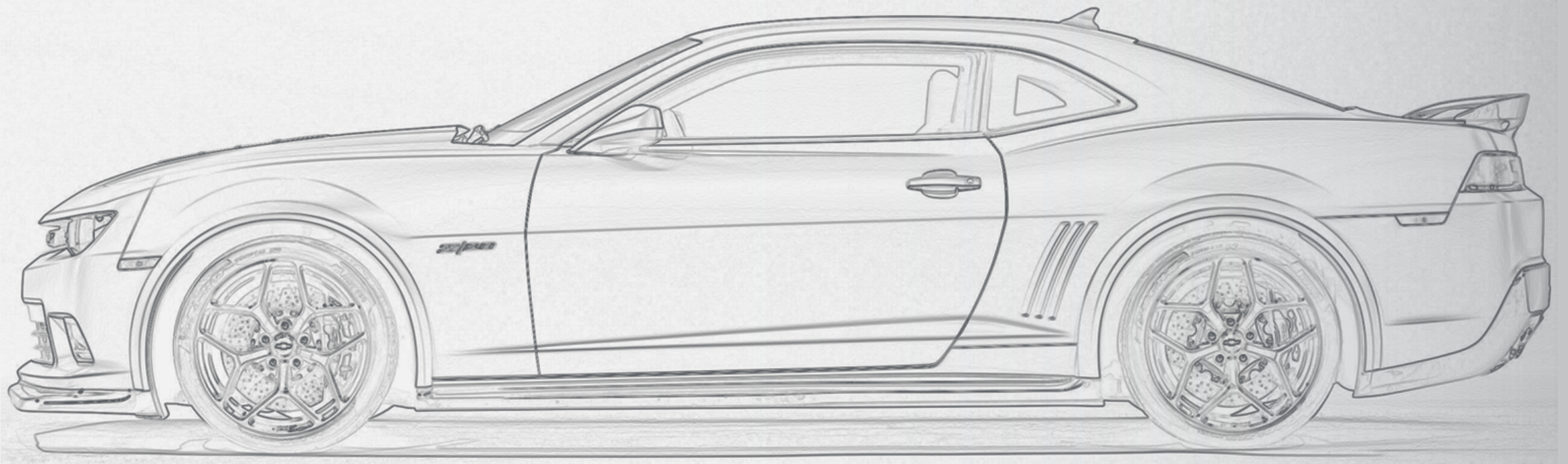
# MARK STIELOW

*Performance Manager*

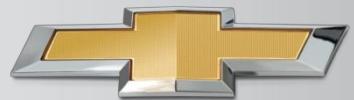




***LIGHTWEIGHTING – TOOK OUT EVERYTHING THAT DIDN'T  
MAKE IT GO FASTER, OR WAS REQUIRED BY LAW***



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# NATURALLY ASPIRATED LS7 ENGINE



- 63.7 lbs (28.9 kg) lighter than LSA
- Lightweight design improves the front-to-rear weight balance for better handling
- Race-proven hardware, including titanium valves, Pankl titanium connecting rods, Mahle pistons

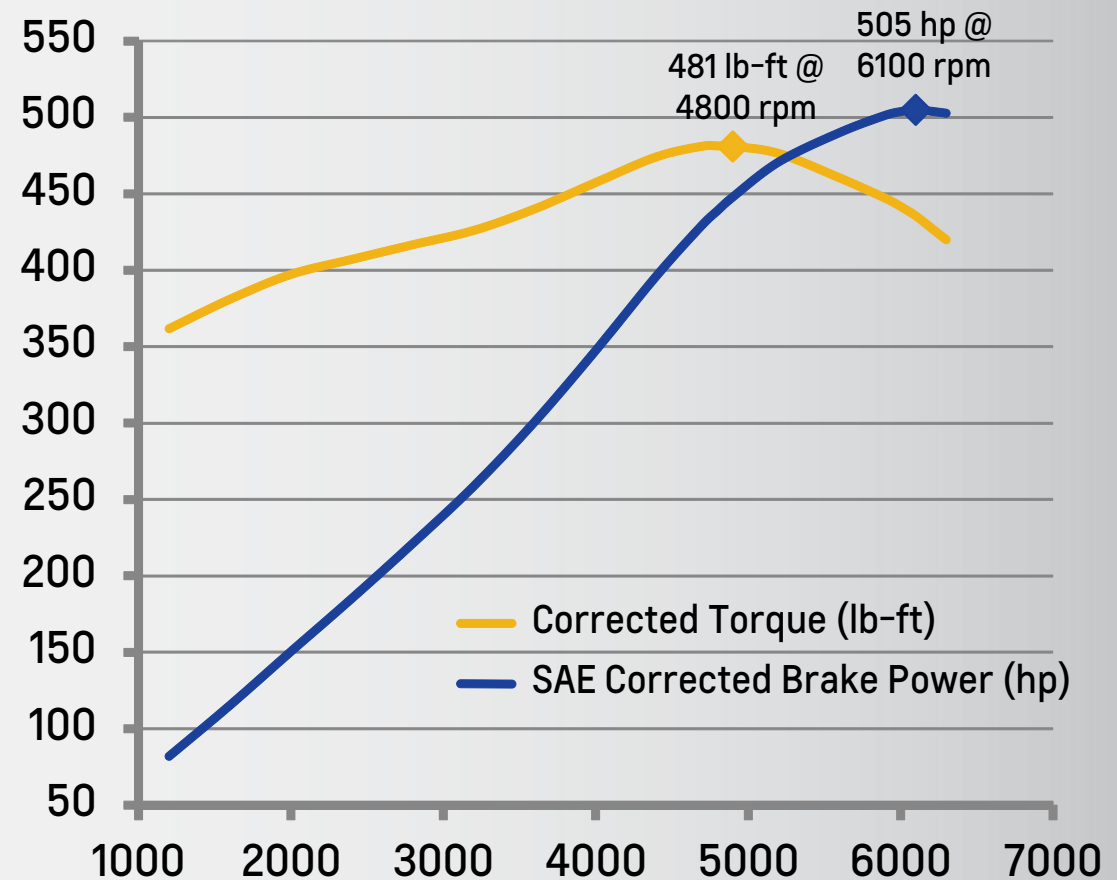




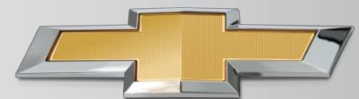
# UNIQUE FEATURES FOR Z/28



- Pankl titanium connecting rods
- Mahle pistons
- Intake, including K&N cold-air induction and exhaust headers
- SAE-rated 505 horsepower (376 kW) and 481 lb-ft of torque (652 Nm)



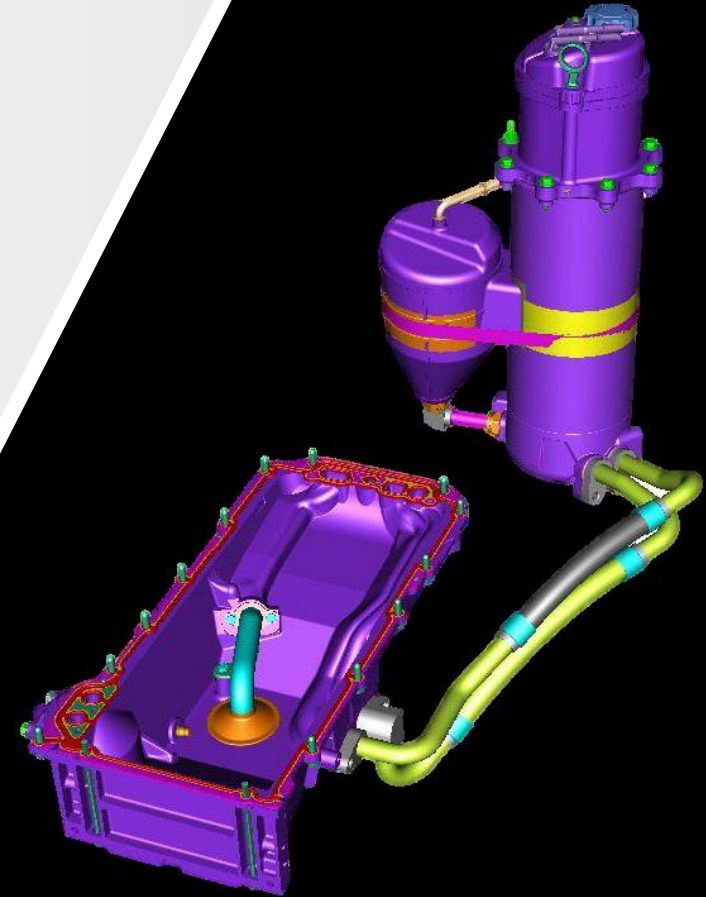
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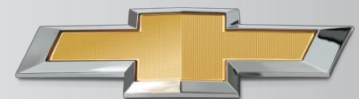
# STANDARD DRY-SUMP OILING SYSTEM



- First production dry sump lubrication system in a Camaro
- This race-inspired system enables high lateral acceleration without a loss in oil pressure or delivery
- Designed for high RPM and high G cornering capability



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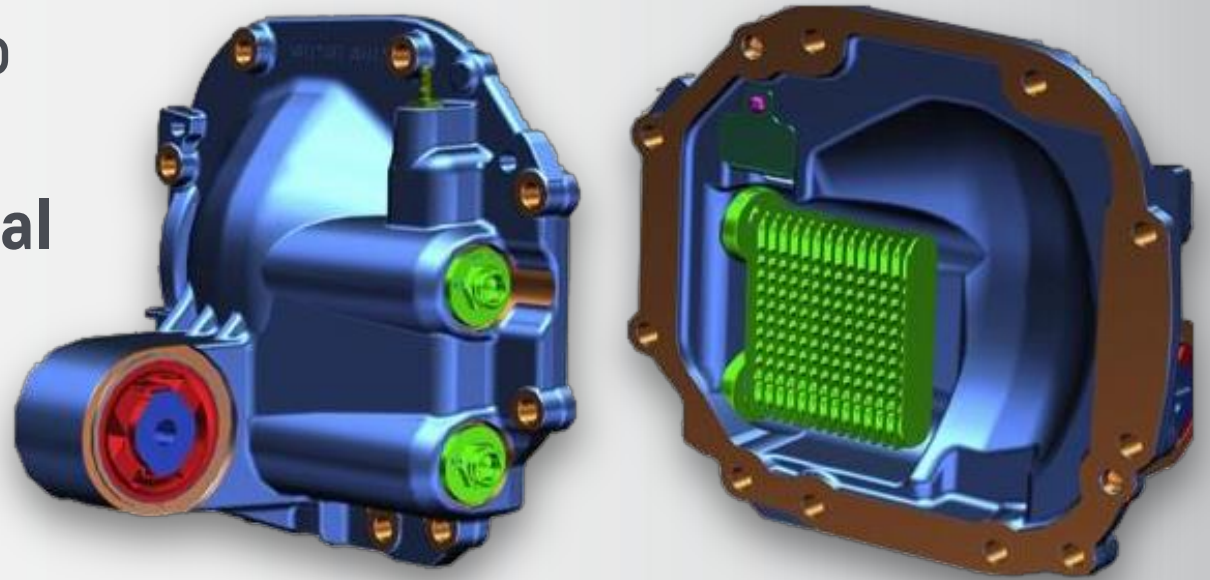


# STANDARD TRACK-CAPABLE COOLING SYSTEMS



Z/28 equipped with all of the cooling equipment necessary for track use, including:

- Engine oil cooled by an integral liquid-to-liquid system, similar to that found on the Corvette ZR1
- The **transmission and differential** are cooled by a high-capacity liquid-to-liquid oil cooler system, similar to Camaro ZL1



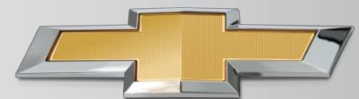


# POWERTRAIN – TRANSMISSION



- Tremec TR6060 six-speed manual
- Close-ratio gearing and 3.91:1 final drive ratio, optimized for the power characteristics of the LS7
- Combination of double-cone and triple-cone synchronizers on all gears
- Synchronizers act like clutches to speed up or slow down a the shifted gear
- Double-cone synchronizers have two friction surfaces to affect gear acceleration
- Triple-cone synchronizers have three friction surfaces. The greater the friction surface, the easier the transmission is to shift

<u>Gear ratios</u>	<u>Camaro SS</u>	<u>Camaro Z/28</u>
1st	3.01	2.66
2nd	2.07	1.78
3rd	1.43	1.30
4th	1.00	1.00
5th	0.84	0.74
6th	0.57	0.50
Final drive	3.45	3.91



# TORSEN HELICAL LIMITED SLIP

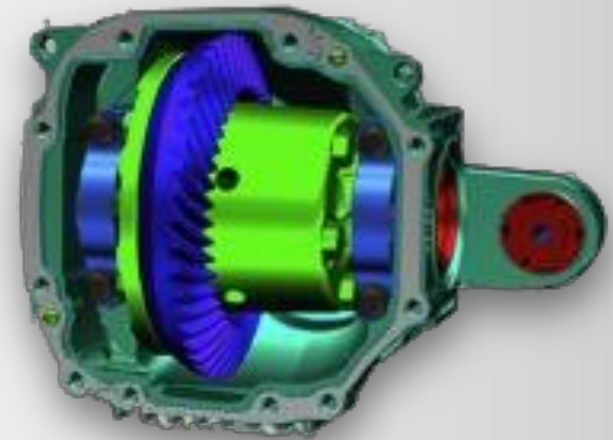


**Cuts 0.7 seconds per lap at Milford Road Course**

**Traditional limited-slips are biased for on straight-line traction**

**Helical limited slip can be optimized for three phases of a corner:**

- Corner Entry – low coupling allows ABS to function for individual wheel sides
- Mid-corner – zero preload improves steering precision and vehicle speed
- Corner-exit – rapid torque coupling increases traction powering out of the corner



# LIGHTWEIGHTING – METICULOUS SHEDDING



5 biggest	Weight savings	5 smallest	Weight savings
21.92 kilograms	Wheel (8.7 kg) and tire (13.2 kg) package	400 grams	0.3-mm thinner rear glass
12.9 kilograms	Air conditioning is only available as a stand-alone option	500 grams	Stripped the redundant wiring out of the harness
9.6 kilograms	Carbon ceramic brakes	1.8 kilograms	Removed floor mats
4.7 kilograms	Lighter rear seat assembly	2.7 kilograms	Eliminated the tire-inflator kit, except for Rhode Island and New Hampshire, where it is required by law
4.6 kilograms	Acoustic deadener/insulation	2.7 kilograms	Removed trunk trim



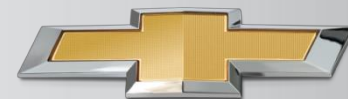
# INCREASED BRAKING PERFORMANCE



*Focused on latest possible braking zone  
and consistent braking, lap after lap*



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# STANDARD CARBON CERAMIC BRAKES



Lightweight, saving 9.6 kg

Ultimate in fade resistance

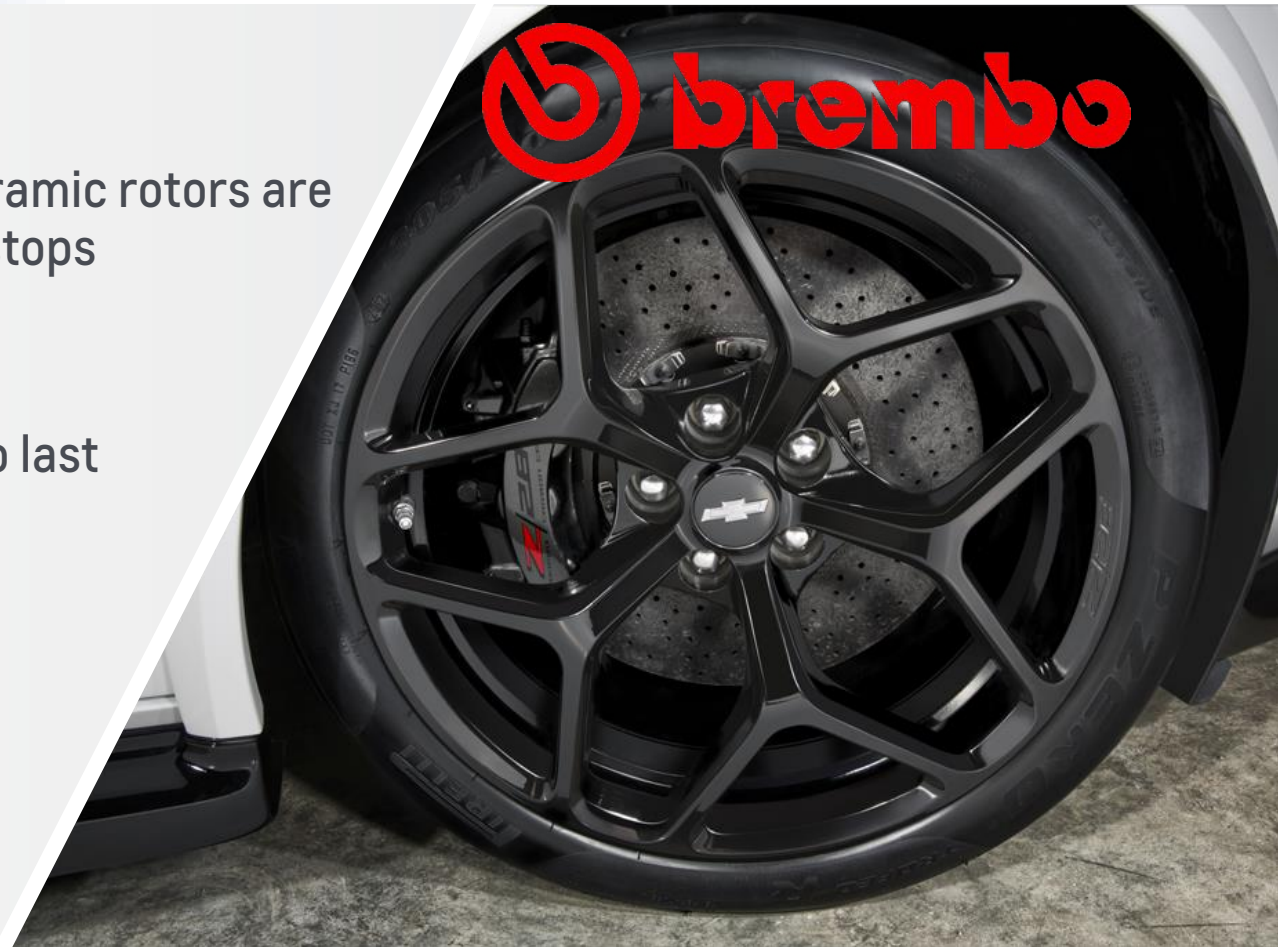
- Standard brake-cooling ducts and carbon-ceramic rotors are designed to stand up to repeated high speed stops

**Carbon-ceramic composite two-piece rotors**

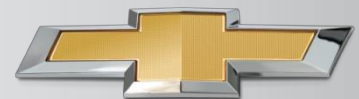
- 394 x 36 mm front, 390 x 32 mm rear
- Incredibly durable, with the rotors expected to last 20 times longer than the pads

**Fixed, monobloc 6-piston front, and 4-piston rear calipers**

- Asymmetric 6-piston layout for improved clamping-force distribution
- Increased pad surface area for improved pad-life and reduced energy unit loading



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# FIRST OEM FITMENT OF PIRELLI TROFEO R



305/30-ZR19 at all four corners, are the widest front tire on any production car



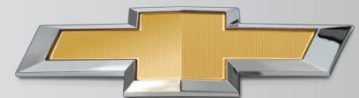
Wheels are staggered: 19 x 11 front; 19 x 11.5 rear to improve rear tire handling at the limit

19-inch diameter wheel/tire package

- Saves 21.92 kilograms (48 pounds)
- Lowers the center of gravity by 33 millimeters, further improving handling



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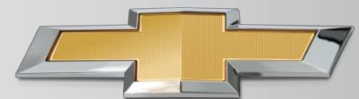
# INCREASED GRIP



*Focused on maximum cornering speeds  
and predictable, confident handling*



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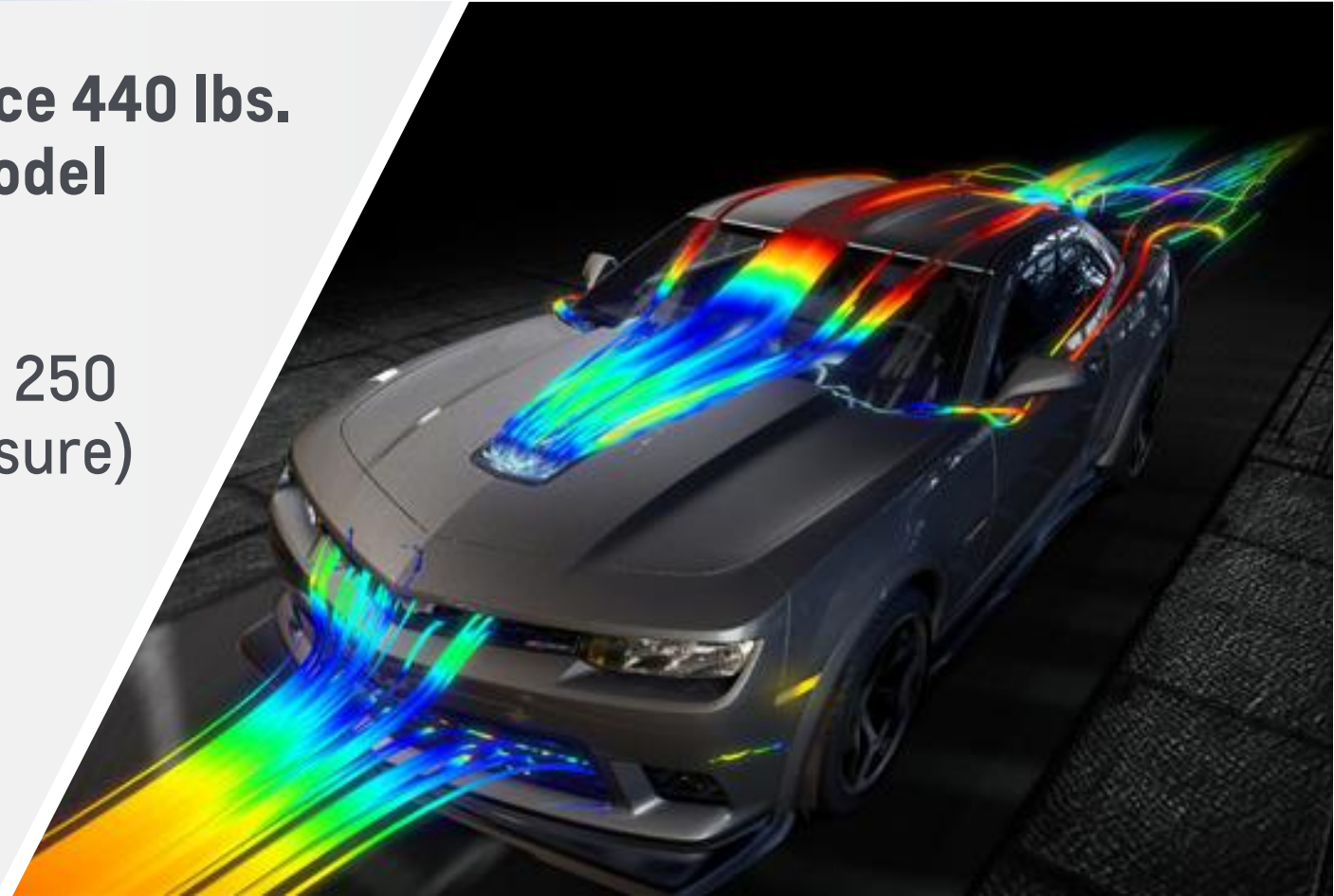
# AERODYNAMICS – INCREASED DOWNFORCE



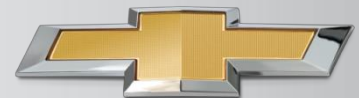
At 150 mph, the Z/28 will produce 440 lbs. more downforce than the SS model

Z/28 features functional:

- Front splitter (can withstand 250 pounds of aerodynamic pressure)
- Rear spoiler
- Hood vent
- Rockers
- Gurney lip fender flares



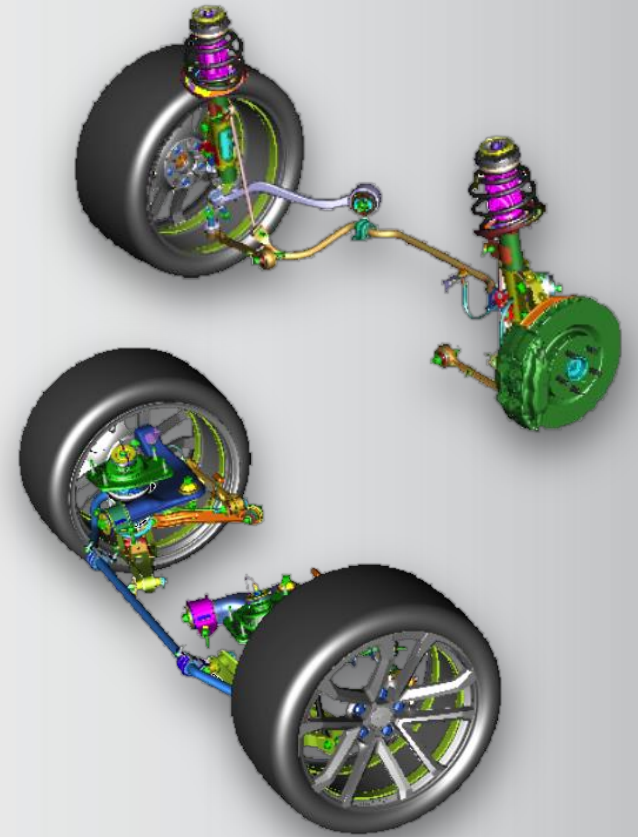
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# NEW SUSPENSION COMPONENTS



- 85 percent stiffer front springs, and 65 percent stiffer rear springs, are optimized to match the new DSSV dampers
- 25 percent stiffer lower trailing-link bushings on the rear suspension improve lateral stiffness in cornering and reduce wheel deflection during hard braking
- 50 percent stiffer lower-arm link bushings on the front suspension, improve steering feel
- 400 percent stiffer rear upper control arm bushings improve lateral stiffness to cope with 1.08 max-lat cornering
- Smaller stabilizer bars (from 28 to 25 mm front; 27 to 26 mm rear) are tuned to match the reduced rebound travel

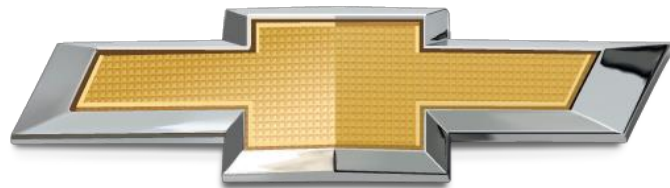




**LARRY HOLT**

*Vice President, Multimatic*





**CHEVROLET**

**Achieving the  
Most Track Capable Production Camaro – Ever**

October 15<sup>th</sup>, 2013

Introduction to Multimatic  
Introduction to DSSV® Technology  
DSSV® History - From Race to Road  
DSSV® - Tuning the Z/28  
The Driving Experience



**Presented by:**

**Larry Holt**  
V.P. Engineering  
Multimatic Inc.  
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Markham, Ontario, Canada  
[lholt@multimatic.com](mailto:lholt@multimatic.com)



Multimatic provides manufactured product and engineering services to the global automotive industry, and participates in the industry at every volume level.



Pioneered in Champ Car in 2002

- Won 5 Champ Car championships

Damper of choice for major Formula One teams including Red Bull Racing

- Won the 2008, 2010, 2011, 2012 Formula One World Constructors' Championships
- Red Bull is leading in 2013, again on DSSV®

Factory installed on Acura LMP1/2 and Courage LMP sports cars, and damper of choice for race teams around the globe

- 20 of the 56 entries in the 2013 24 Hours of LeMans used DSSV® dampers

The spec damper for DTM, Formula 3 and Ferrari 458 Challenge

Factory equipment on the exclusive Aston Martin One-77





# DSSV® History - From Race to Road

## The Ultimate Track Car

With the release of the Camaro Z/28, Multimatic's race winning DSSV<sup>®</sup> technology will be available to a wider audience.





DSSV® is an acronym for Dynamic Suspensions Spool Valve

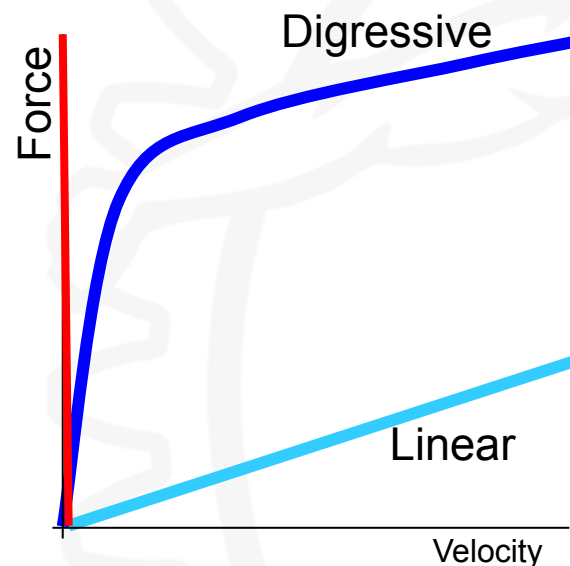
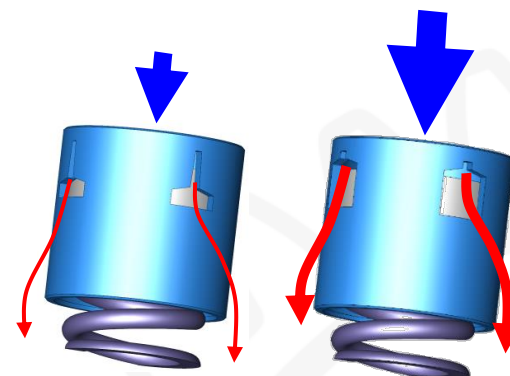
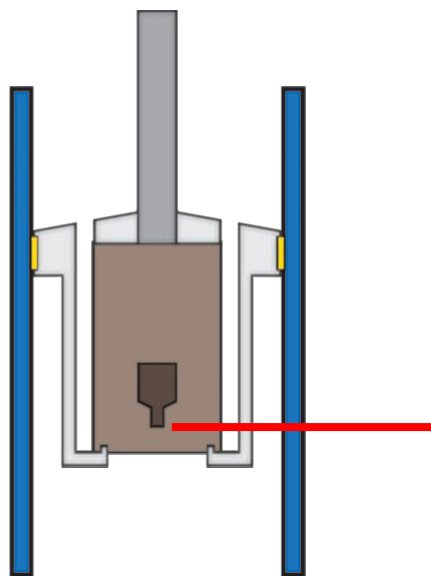
- DSSV® dampers use *precision spool valve technology* to deliver the highest level of damper predictability, accuracy and repeatability. These performance characteristics help the damper deliver the ultimate in wheel and vehicle control.

Shim dampers rely on a stack of flexible steel disks to regulate oil flow through a series of orifices.



DSSV dampers regulate oil flow via shaped ports.

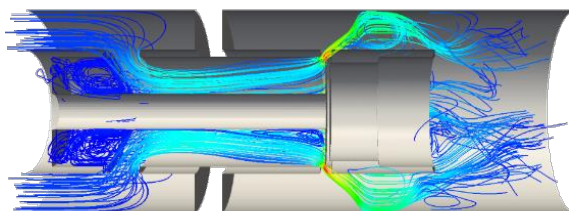
- The shape of these ports defines the characteristic force-velocity curve of the damper



## Introduction to DSSV® Technology Performance Fundamentals

DSSV® delivers superior suspension performance by:

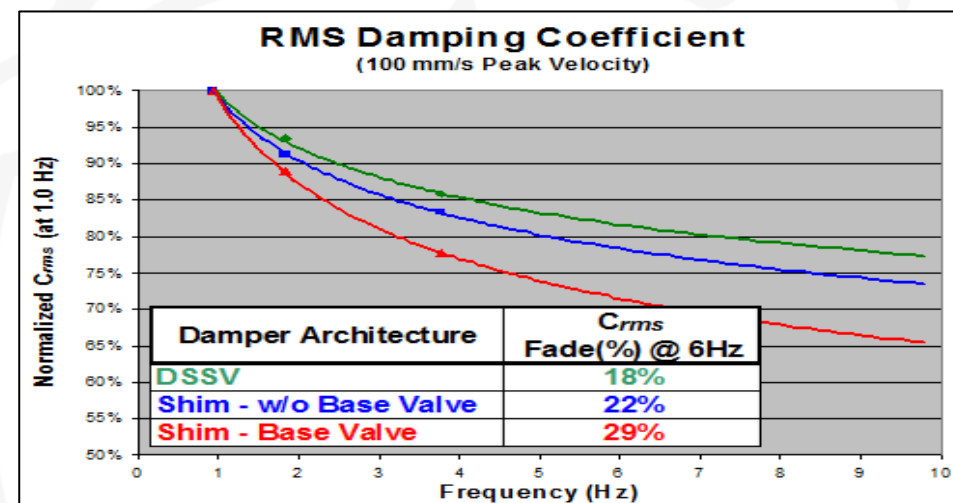
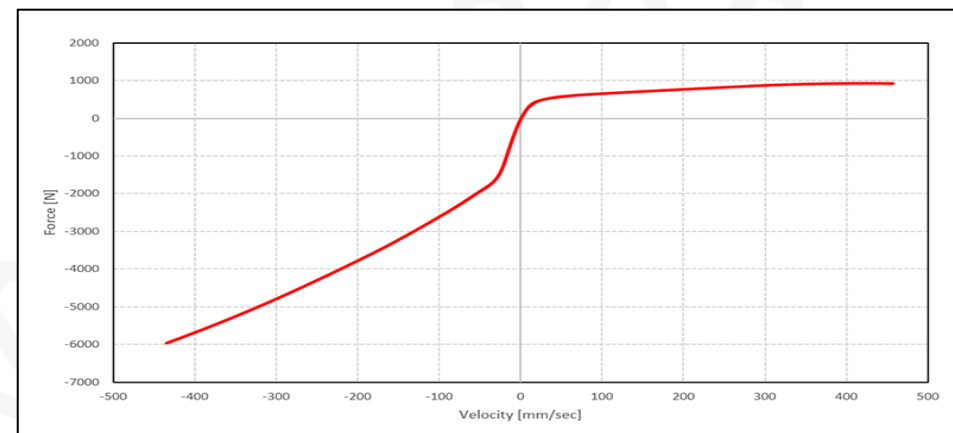
- Enabling the generation of any required force-velocity characteristic
- Reducing flutter and overshoot which results in superior transient response
- Delivering minimized fade at increasing frequencies
- Operating in a turbulent oil flow regime, thus assuring thermal insensitivity



CFD of DSSV® damper showing velocity trace-lines

Spool valves are analytically determinate

- DSSV® damping characteristics are mathematically predictable using Specfinder™ software

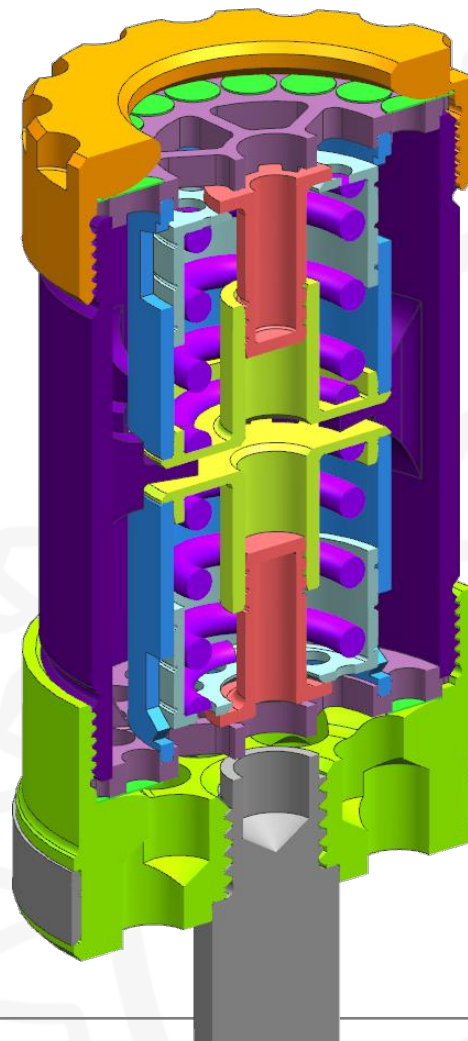




# Introduction to DSSV® Technology Inside the Z/28 Dampers

## Inside the Camaro Z/28 dampers

- Two independent, self-piloted spool valves allow for *fully independent* tuning of compression and rebound characteristics
- Both front and rear utilize the same spool-in-piston monotube architecture, allowing maximum piston diameter for the available package space

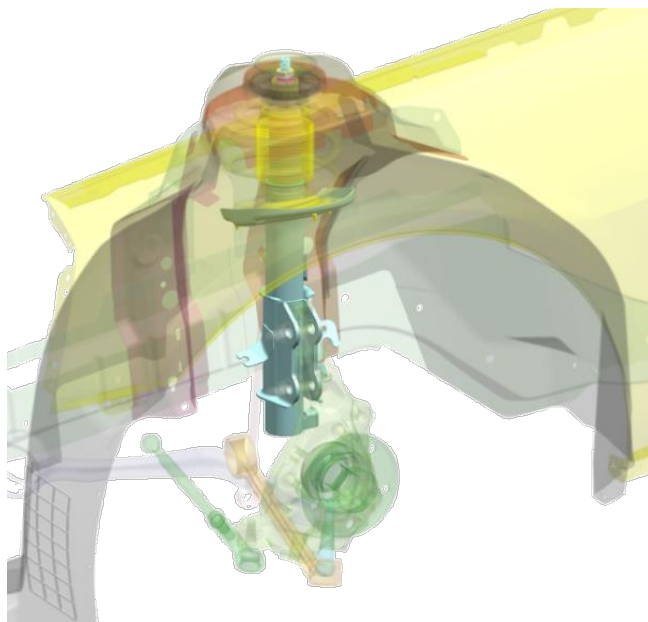


# Introduction to DSSV® Technology

## Z/28 Front Configuration

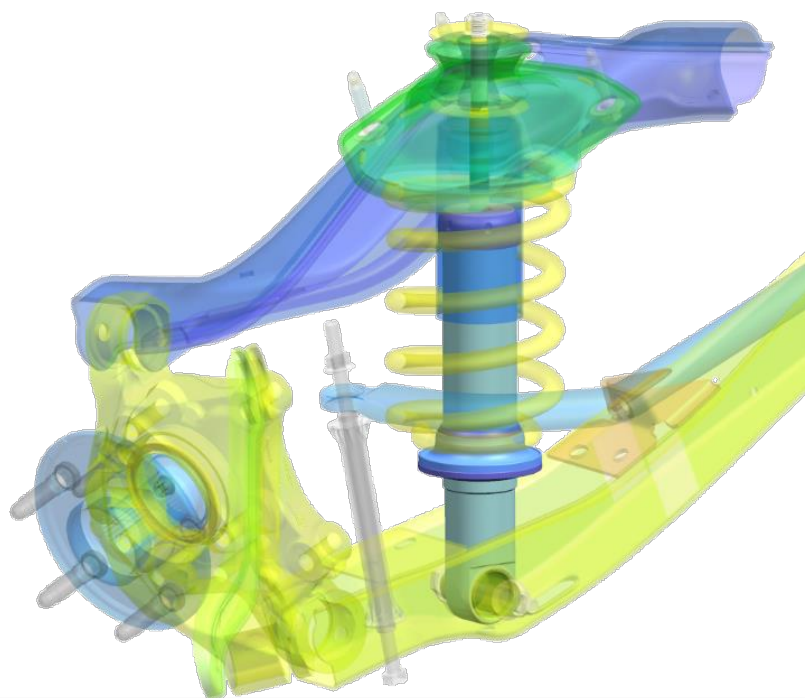
### Front spool-in-piston super-strut

- Inverted monotube strut with a 40mm piston and a 45mm OD insert tube assures high bending stiffness, resulting in improved steering feel, vehicle response and maximum cornering capability



### Rear spool-in-piston damper

- Rear package space allows 45mm diameter piston
- The impact extruded aluminum body results in a mass saving of 2.6 lbs (1.2 kg) / vehicle compared to standard Camaro damper

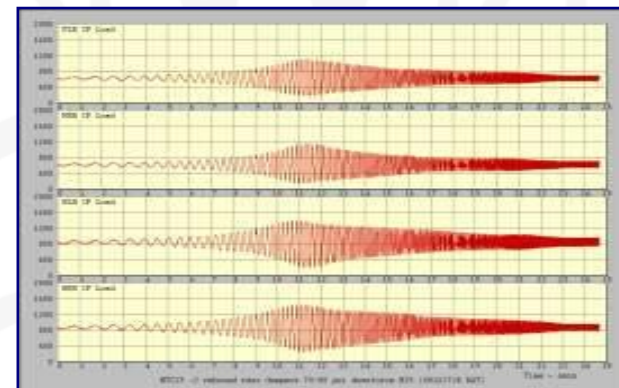




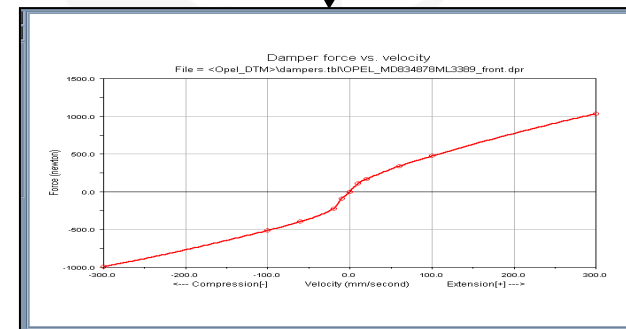
# Tuning the Z/28 Multi-Post Rig Testing

Multimatic supported Camaro Z/28 development with engineering and manufacturing expertise, leveraging specialized tuning tools and services:

- Multi-post rig
  - *Used to tune suspension system performance by characterizing and optimizing vehicle modal response*



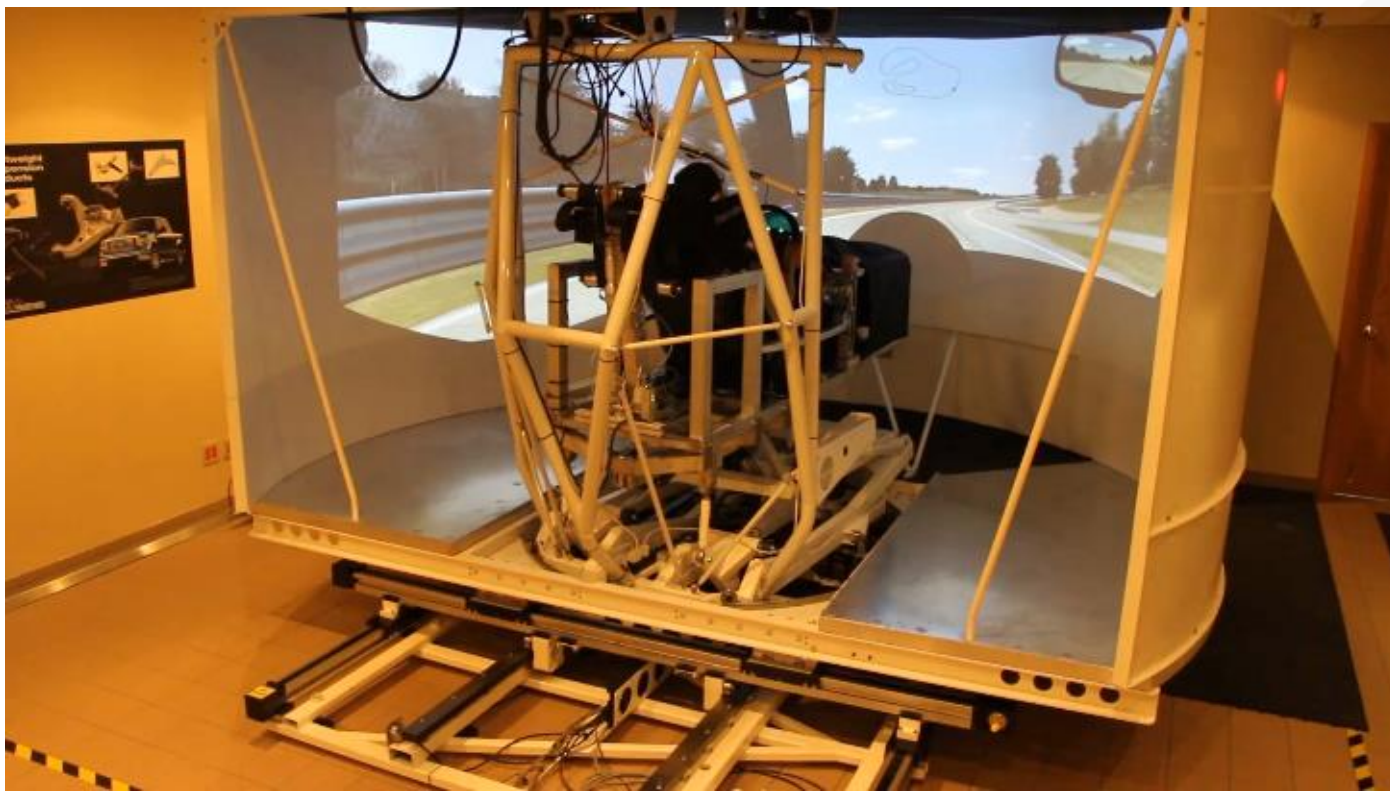
**Optimal Vehicle Response**



**Optimal Damper Curve**

Multimatic and GM's Z/28 development engineers used Multimatic's full motion, "Hardware and Driver-in-the-Loop" simulator to:

- Provide early feedback regarding proposed engineering and tuning parameters
- Quickly evaluate multiple suspension iterations



**The Multimatic Dynamic Simulator was named 2012 Development Tool of the Year by Vehicle Dynamics International.**



Thank You...  
Now Feel the Difference





# AL OPPENHEISER

*Chief Engineer*



Pre-production model shown

**24-HR TEST**



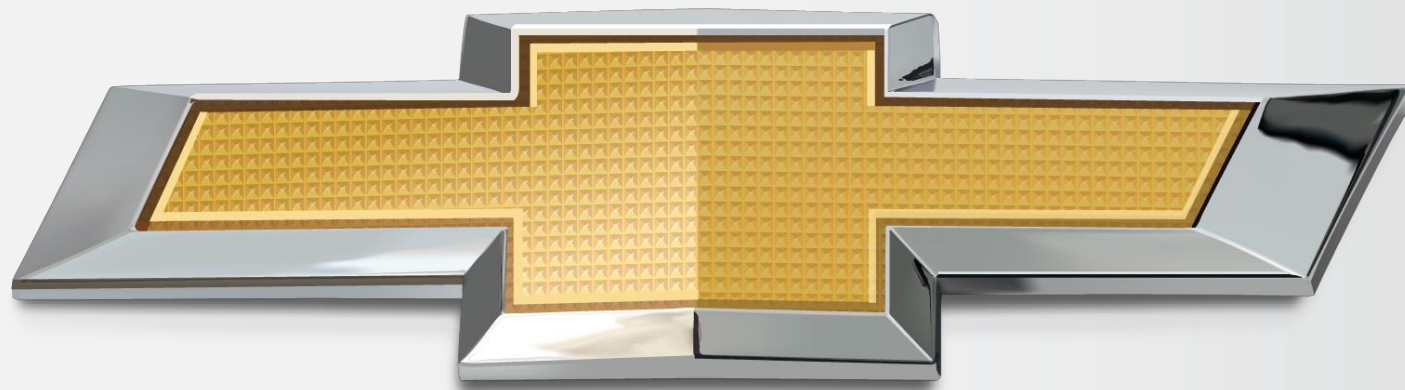


# 24-HR TEST



- Simulates one year's worth of amateur-level track use
- 24 cumulative hours of 10/10th track driving
- Each lap effort needs to be within 2% of fastest lap
- 22 laps at MRC or a tankful
- Can only change brakes and tires





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