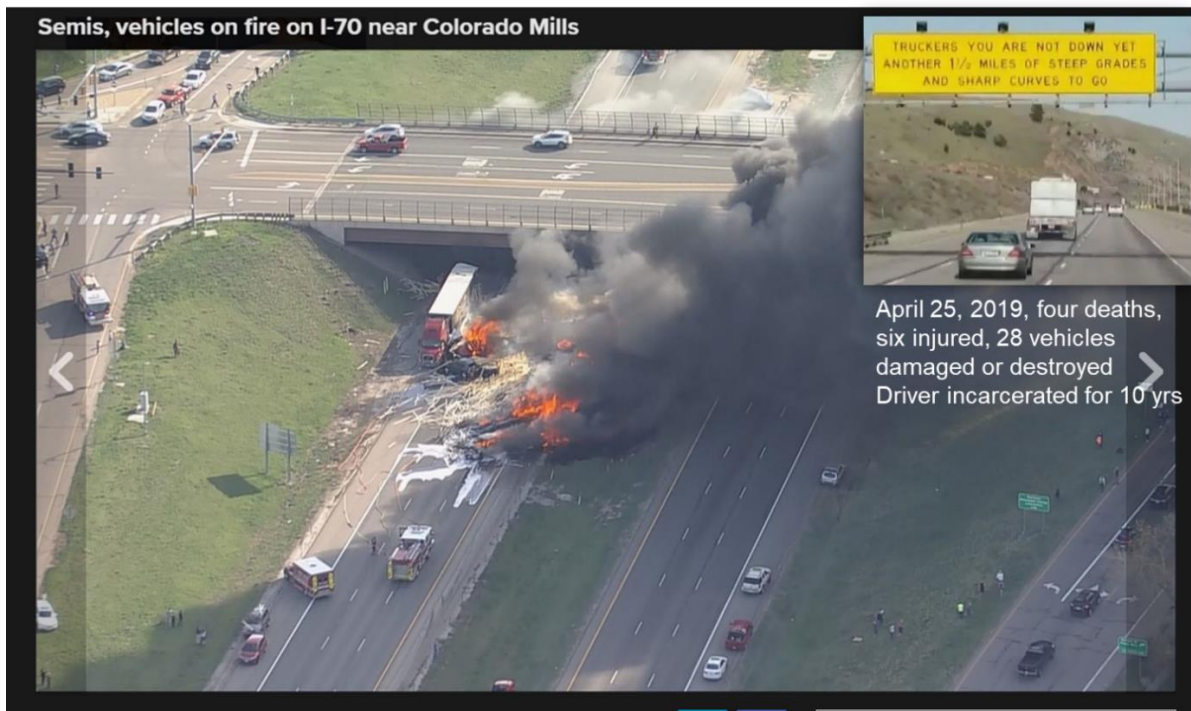


Early Detection and Correction of Risky Driving

"When performance is measured, performance improves."

January 6, 2023

Rogel Aguilera did not intend to kill 4 people. Injure 6 others and destroy 28 vehicles on April 27, 2019, but he found himself at the controls of a fully loaded semi-truck, careening on the edge of control, down the Genesee Hill on Interstate 70 eastbound into Denver, Colorado. He blew past an escape ramp and an exit to C470 which was his last chance to avoid a catastrophe. There was a tailback on I70 that morning that extended a mile back from an upcoming overpass. When Rogel approached the end of the tailback at 80 mph he moved over to the paved shoulder and managed to avoid a long line of vehicles. But then his luck ran out as he approached the overpass where the non-driving lane ended. Rather than smash head on into the abutment he merged into the stationary lane of traffic with tragic consequences. Rogel is now serving a lengthy prison term and the small trucking firm that employed him declared bankruptcy.



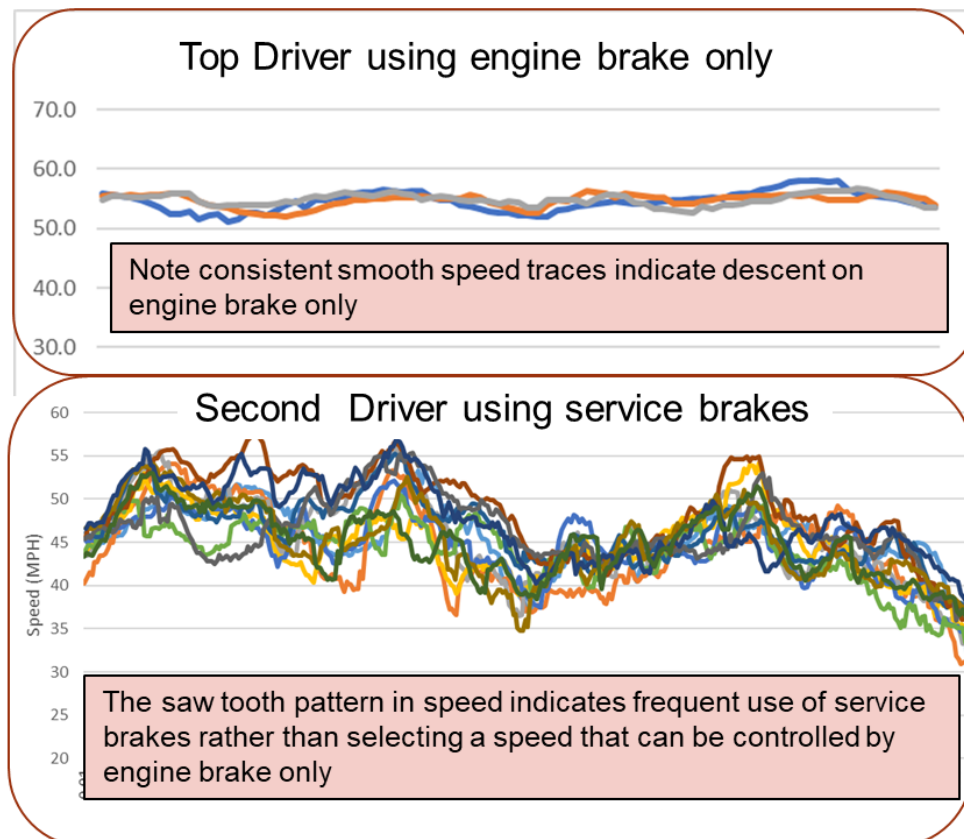
Rogel had been driving trucks for 2 years in Texas, but this apparently was his first trip through the Colorado mountains. He did not select a gear ratio and engine brake setting that would yield a controlled descent with only the minimal use of his service brakes. Thus, when he needed his service brakes to stop for the tailback, they were overheated and ineffective. CDL (Commercial Drivers License) and owners' manuals consistently instruct drivers to manage descents using engine brake only, preserving the service brakes for emergency stops. The same manuals cryptically note that safe descent

speeds are equal to the speed that the truck can manage during the ascent. Unfortunately, many drivers forget or ignore these instructions.

The driver's task is further complicated by the fact that safe speeds on descents (or curves) vary widely by the gross weight of the vehicle, the configuration of the trailer or trailers, the height of the load, and the specifications of the tractor. For example, the Genesee descent can be made safely at the posted speed (35 mph) if the truck is empty even with the engine brake set at medium. However, a fully loaded truck with the engine brake on high should descent at 28 mph or less depending on engine braking effectiveness. Unfortunately, there is nothing in the cab currently that provides the driver with a calculated safe speed based on these factors and the geometry of the road ahead.

While working with a bulk hauler to measure driver behavior in mountainous terrain, we noted a distinct difference between driver speed profiles captured on long descents. The top drivers in our testing were careful to select the high setting on the engine brake and then the correct gear ratio so that at 1900 to 2000 rpm the tractor would maintain a safe descent speed for the entire descent. Aggressive or careless drivers were making the descents at speeds that were 20 to 30 percent higher and requiring the use of service brakes to manage the higher descent speeds. During the study, **Road-Aware** (a large truck safety application developed to prevent rollovers and runaway crashes) was used to capture GPS positions every second, translating these into speed profiles. The speed traces shown below illustrate the different descents¹.

Improper use of service brakes on long descents

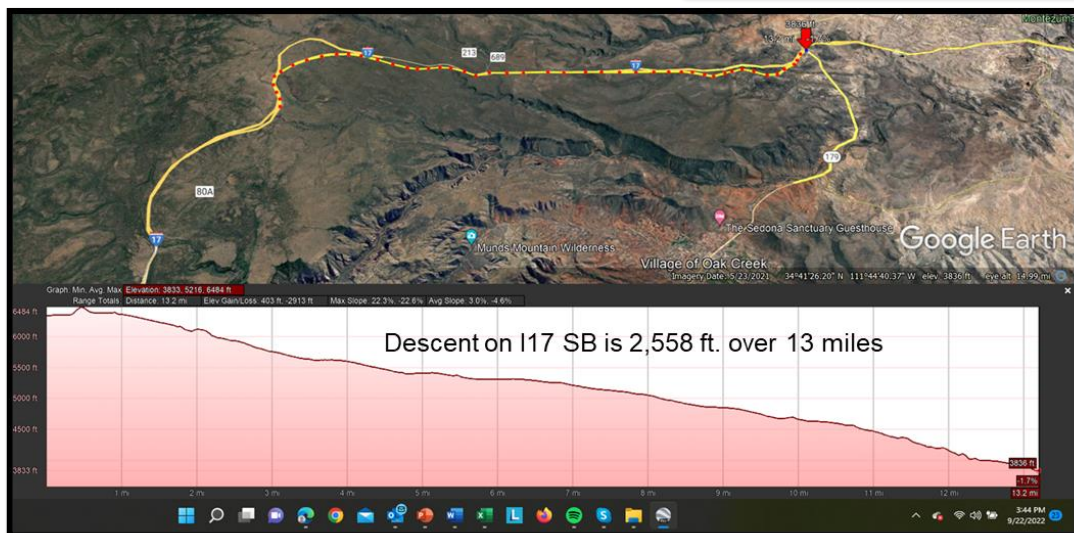


The problem with frequent use of the service brakes is the risk of overheating the brakes. Brake temperature is not measured or presented to the driver. Brake effectiveness remains fairly constant until the brakes reach a critical temperature (approximately 650 °F but varies by type of brake pads). Above the critical temperature, braking effectiveness declines rapidly.

After a recent coaching session with a driver who was using a descent speed that required use of the service brakes, and was taking curves too fast, the driver's manager asked which of the driver's habits was the most dangerous. We replied that taking curves too fast usually resulted in a single vehicle rollover crash. These crashes occur more frequently than runaway crashes², but they are generally nonfatal. The truck and load can be replaced or repaired, and the financial costs are usually within the capacity of the company and the insurance coverage. However, we noted that just a few days earlier (Sept. 18, 2022) there had been a runaway crash on Interstate 17 just north of Camp Verde, Arizona that resulted in the deaths of four people. We then stated that if the truck in that crash had been owned by their company it likely would have been an 'end of life' event for the company. Their liability insurance coverage is limited to \$5 million per incident which would have been totally inadequate for a crash of that severity.

Sept. 18, 2022: A family of four killed by a semi-truck .

[Truck driver told police his brakes failed prior to crash that killed four in Arizona \(cdllife.com\)](https://www.cdllife.com)

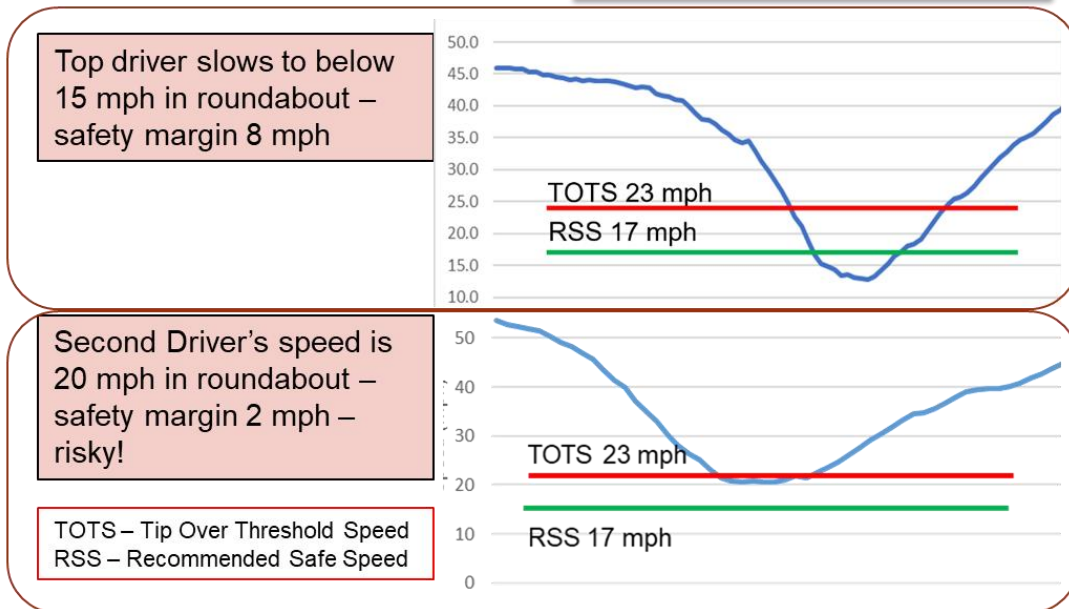


The company driver was also coached about his speeds through three roundabouts on US 93 in Wickenburg. The top drivers consistently lowered their speeds to 15 mph or lower through these features. The driver we were coaching was going through at 20 to 21 mph. During the testing period a

semi-truck rolled over on one of the roundabouts. As is the case with descents, safe speeds on curves vary widely with trailer type, trailer configuration and the height to the center of gravity of the load. Thus, a tractor pulling a flat bed with a load of rebar can safely navigate curves at a higher speed than one pulling a fully loaded dry bulk trailer. We noted that the **Road-Aware** calculated tip over threshold speed was 23 mph. for a dry bulk load. We asked the driver being coached if he was aware that he was driving within 2 mph of the tip over speed. As expected, he was surprised that he was driving so close to the edge of control. Again, there is nothing in the cab to provide a driver with a calculated safe speed.

Safe Speeds in roundabouts

Rollover Crash on US 93 Roundabout Aug. 26, 2022

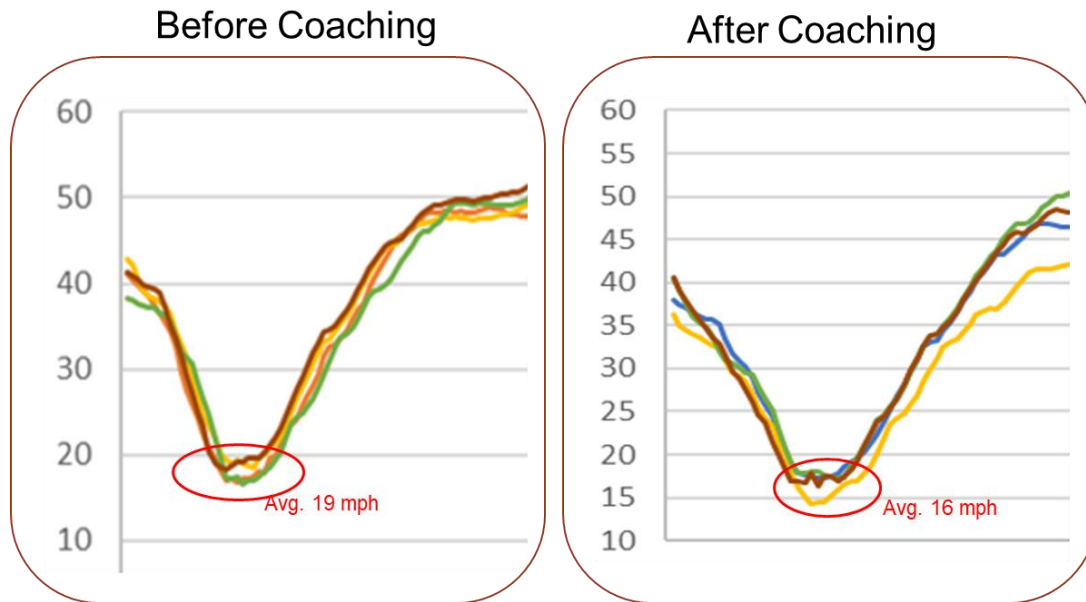


The good news is that new technologies such as **Road-Aware** can be used to identify risky driving behavior within the first few weeks of hiring. Furthermore, the risky behaviors can be measured, recorded, and scored. Doing so empowers managers to take remedial actions such as coaching the driver and providing on-line training aids. Many drivers simply do not understand the physics involved in the vehicle dynamics that control truck behavior on curves and descents. Objective measurements of the driver's own behavior provide managers with a powerful tool to coach the driver by teaching speed control and demanding a change in behavior.

Follow on measurements can be used to verify improved driving behavior as illustrated in the graphs below. The differences in speed may seem low to the casual observer. However, the 3-mph reduction doubles the speed safety margin (driver was using a 3-mph safety margin that is now increased to 6 mph). The increased safety margin for the centripetal force (or tip over force) is even greater since it

varies as the square of velocity. In the example illustrated above, the tip over threshold speed is 23 mph. If speed is lowered by 30%, (6 mph), the tip over force is reduced by 50%.

Driver Lowers Speeds in Roundabouts after Coaching



The examples cited in this paper also illustrate that driving safely does not result in a reduction in efficiency. The extra time required to make the descents on engine brake only adds 2 minutes to a 12-minute descent. Slowing to 70% of the tip over threshold speed similarly adds only 15 seconds or so to each geometry. In a typical 300 mile run through the mountains, using safe speeds, only adds about 12 minutes to the driver's day. The payoff is total elimination of 'truck at fault' runaway and rollover crashes in addition to reduced brake and tire wear.

Working with clients, we have found the following:

1. Aggressive or sloppy driving techniques are easily identified using detailed speed profiles in difficult road geometries.
2. Drivers will improve driving behavior when the coaching is based upon objective data of their performance measured against calculated safe speeds.
3. Drivers may even improve driving behavior simply by letting them know they are being measured.
4. Providing drivers with a better understanding of safe speeds in curves and on descents using actual examples from the routes they run results in better performance.
5. Using technology like **Road-Aware** to measure and correct driver performance on a consistent fleet-wide basis can reduce or even eliminate certain types of single vehicle crashes.

If companies will take these steps to improve driver performance, risky driving behaviors can be eliminated. Eliminating risky driving behavior will reduce the probability of crashes by 50% or more as noted in a recent study by ATRI³. By so doing, companies will save money by reducing the frequency and severity of single vehicle crashes and truck at fault collisions. Companies may also avoid a catastrophic crash and subsequent damages that could imperil the entire organization.

For those readers that wish to adopt a risk management process we recommend the following:

1. Start with routes that are used frequently where the roads have challenging geometry.
2. Select 8 to 12 segments on the route that have tough geometry. Include sharp curves, connector ramps, roundabouts, exits, long descents and others.
3. Measure driver speeds through these features at one record per second using a product like **Road-Aware**.
4. Compare the speed profiles to the recommended safe speeds provided by **Road-Aware** for each feature.
5. Analyze the performance of each driver, coach the driver and repeat the measurements until performance improves.

To get started, these three simple steps will improve driving performance:

1. **Have your drivers watch the excellent descent videos⁴ published by Jim Park, Truck News.**
2. **Have your drivers read our white paper on Curve Speed Safety.⁵**
3. **Join us in using a safety software like *Road-Aware* to assess and improve driving behavior.**

Garth Lawrence – Founder & Managing Director, Road Aware Safety Systems LLC

Brian Bullock – Founder & Principal, Road Aware Safety Systems LLC

Contact us at [Road-Aware Safety Systems LLC](#)

Notes:

1. These speed profiles were captured using the **Road-Aware** system installed on an 8-inch Samsung tablet mounted temporarily in the cab with only a power connection.
2. Although runaways are less frequent than rollover crashes, runaway ramps are used regularly. AZ DOT noted that the runaway ramp on US60 westbound just before Superior, Arizona must be regraded several times a week because of usage by runaway trucks.
3. [Predicting Truck Crash Involvement: 2022 Update – TruckingResearch.org](#)
4. [Mountain Driving 101: Video series guides truck drivers in the mountains - Truck News](#)
<https://www.trucknews.com/equipment/mountain-driving-101-video-series-guides-truck-drivers-in-the-mountains/1003148837/>
5. [Curve Speed Safety Paper Dec 20 2018 .pdf \(wsimg.com\)](#)
https://img1.wsimg.com/blobby/go/d6dbf72a-5a03-490c-9245-ca8b0298ed58/downloads/Curve%20Speed%20Safety%20Paper%20Dec%202020_2018%20.pdf?ver=1626735052534

