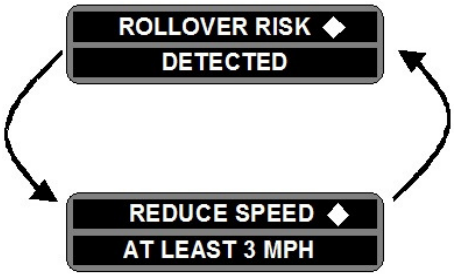
Vehicle Stability Systems

Objective

Vehicle Stability Systems (VSS) monitor lateral acceleration from on-board sensors to reduce rollovers due to excessive speed in a curve and/or prevent loss-of-control crashes due to yaw instability. Currently available VSS include Roll Stability Advisors (RSA), Roll Stability Control (RSC) systems, and Electronic Stability Control (ESC) systems, also known as Electronic Stability Programs (ESP).

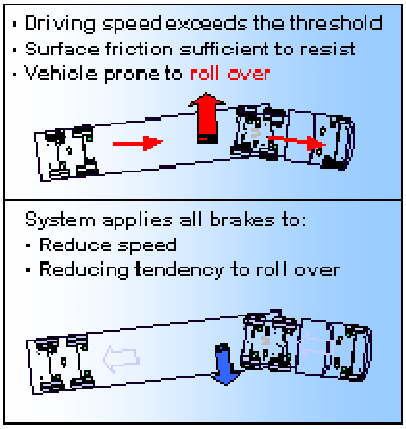
Description

Roll Stability Advisors (RSA) are passive systems that inform the driver about significant rollover risks. Currently available RSA do not deliver an immediate warning of an impending rollover; they provide an advisory message within seconds after the event has occurred with the purpose of improving the driver's performance in similar future driving situations.



Roll Stability Advisor Message

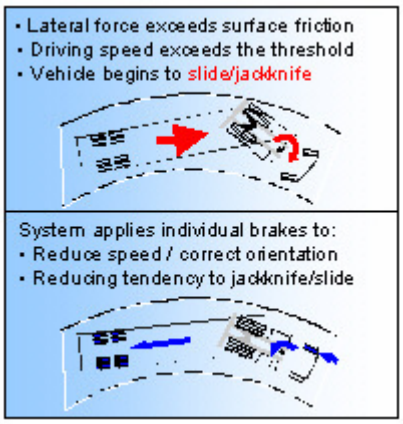
The RSA monitors lateral force information received from on-board sensors and determines when an advisory is warranted. The advisory is an audible alert and visual message to the driver. The wording of the message, the length of display time, and the duration of an audible alert are associated with increasing levels of rollover risk severity. For some systems, the text message displays the consequential advisory on risk and recommended reduction of speed. The speed reduction advisory is variable and calculated based on the observed speed and lateral acceleration during the risky event. Using GPS and the driver's previous operational behavior, future RSA systems are evolving toward predicting rollover risk seconds before the critical situation occurs.



Roll Stability Control System

Roll Stability Control (RSC) systems are active systems that automatically intervene if a high rollover risk is detected due to excessive speed in a curve. In an imminent rollover situation, the system intervenes by automatically reducing the throttle and applying the engine and foundation brakes without action by the driver. The RSC system is typically integrated with antilock braking systems, but some systems are integrated with electronically controlled braking systems.

Electronic Stability Control (ESC) systems, also known as Electronic Stability Programs (ESP), are active systems that automatically intervene when there is either a high risk of rollover or yaw instability. In currently-available systems, the ESC system's electronic control unit continuously compares the vehicle's actual movement to performance models using input from the wheel speed sensors, as well as lateral, yaw, and steering angle sensors. If the vehicle shows a tendency to leave an appropriate travel path, or if critical threshold values are approached, the system will intervene.



Electronic Stability Control System

When a potential rollover risk is detected, the ESC system reduces the throttle and applies the proper brake pressure to slow the vehicle below the rollover risk threshold. When a vehicle slide (over-steer or under-steer) is detected, the ESC system reduces the throttle and then selectively applies the appropriate individual brakes to produce a counter force to better align the vehicle with an appropriate path of travel. In an over-steer situation, the system applies the â€œoutsideâ€ front brake; while in an under-steer condition, the â€œinsideâ€ rear brake is applied. These systems may be integrated with electronically controlled braking systems or anti-lock braking systems. ESC systems cannot increase the available traction, but they maximize the possibility of keeping the vehicle under control and on the road during extreme maneuvers by monitoring the driver's natural reaction of steering in the intended direction in over-steer and under-steer situations.

Applications

Rollovers and loss-of-control crashes can be prevented through the use of VSS with advisory or control functions. To help avoid future rollover situations, RSA are training tools that can advise the driver within seconds that the recent operation of the vehicle was susceptible to a rollover.

With regard to excessive speed, drivers may be under the speed limit, but operating too fast for conditions. Although drivers may think that they know how fast the truck is traveling by the way it feels, their estimates of speed can be off by 10 to 20 miles per hour. Rollovers can occur at speeds below 30 miles per hour, which can be too fast on certain exit ramps and curves. As a result, RSC and ESC systems can reduce the speed of the vehicle to prevent many rollover incidents.

Many loss of control crashes, such as jackknife crashes, occur as the result of an aggressive control action by the driver. Steering to avoid another vehicle and over-correction from a lane departure are typical loss of control actions. ESC systems use automatic braking of individual wheels to prevent the vehicle's heading from changing too quickly (spinning out) or not quickly enough (plowing out).

Operations and Benefits

The movement of goods and products by truck is conducted on all types of roads, at all hours of the day, and in all types of driving conditions. A driver may encounter several types of roadways and situations where the VSS can provide a potential benefit. Normally, VSS will be in a monitoring mode

roads and exit ramps. On flat roadways, rollovers occur on dry pavement when the roadway friction prevents the vehicle from sliding sideways. Jackknifing, plowing out, and spinning out tend to occur on roadways with reduced traction. The driver should be aware that in limited-traction conditions, RSC systems will not prevent sliding incidents while ESC systems address both sliding and rollover situations.

Since the loss of vehicle stability can occur along any route, many fleet types may benefit from the use of VSS. However, these systems may be most promising for tractor-trailer combinations, trucks with high mileage accumulated over their operational life, or trucks that operate under conditions that may present driving challenges, such as roadways of geometry or configuration that can be difficult to negotiate. During the USDOT Field Operational Test, the RSA and RSC systems were found to be particularly beneficial for fleets with tractors pulling tank trailers.

While ESC and RSC systems have proven to be effective, they will not prevent tripped rollovers and crashes caused by sudden turns at high speed or travel on cross-sloped shoulders. The driver is still an integral component in safely operating and maintaining the stability of the vehicle.

Cost

VSS are generally installed by Original Equipment Manufacturers (OEMs) when the vehicles are manufactured, yet some systems may be installed as an aftermarket accessory. The cost of VSS varies greatly depending on a particular system's capability and the number of units acquired. The prices range from less than $500 to slightly over $1000 for the ESC system.

Vendors

Bendix Commercial Vehicle Systems 901 Cleveland Street Iyria, Ohio 44035 1-800-AIR-BRAKE (1-800-247-2725) www.bendix.com	**Freightliner LLC Corporate Communications** 4747 N. Channel Ave. Portland, OR 97217 (503) 745-8000 phone (503) 745-5096 fax www.freightliner.com
Meritor WABCO Vehicle Control Systems 2135 West Maple Road Troy, MI 48084-7121 Ph: (248) 435-8001 Fax: (248) 435-8002 www.meritorwabco.com	**Volvo Trucks North America** 7900 National Service Road Greensboro, NC 27409-9416 Ph: (336) 393-2000 Fax: (336) 393-2900 www.volvotrucks.us.com

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