

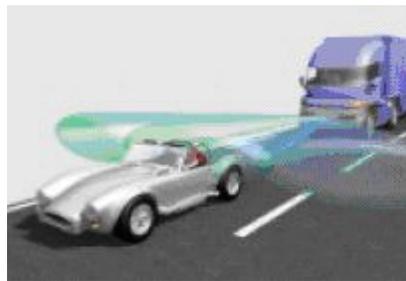
## Collision Mitigation Systems

### Objective

Collision mitigation systems enhance vehicular safety by automatically preventing or reducing the impact of rear-end collisions.

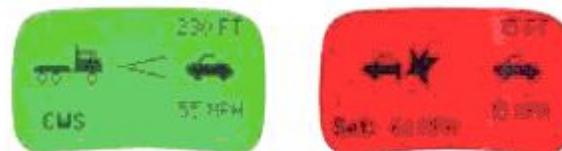
### Description

Collision mitigation systems are forward-looking, radar-based systems comprised of collision warning and adaptive cruise control (ACC) with active braking.



Collision Mitigation Radar-based System (Meritor WABCO)

The collision warning component of collision mitigation systems provides audible and/or visual warnings of vehicles or objects that come within a predefined distance in the front of a vehicle with the system. A radar sensor mounted on the front bumper of the vehicle transmits and receives high frequency radio signals to determine the distance and speed of a target vehicle or object in front of it. Some systems are capable of detecting multiple moving objects at distances up to 500 feet away. When a commercial motor vehicle equipped with this system approaches a slower moving vehicle, a series of progressively urgent warnings are issued from the system according to pre-set thresholds. These warnings are designed to allow the driver adequate time to decelerate the vehicle and adjust his or her driving behavior through targeted feedback for safe following distances.



Meritor WABCO OnGuard Collision Mitigation Driver Display

The ACC component of collision mitigation systems supplements the normal vehicle cruise control by automatically attempting to maintain a safe following interval between the vehicle with the system and a vehicle in front of it. ACC interacts with the commercial vehicle's engine management system (transmission and throttle) and brake control system to adjust the speed of the vehicle when necessary.

When vehicle deceleration is required or a potential rear-end collision is imminent, the collision mitigation system automatically de-throttles the engine, applies engine brakes, and if necessary, applies the foundation brakes. Responses from the engine, transmission, and anti-lock braking systems are coordinated through communications across the SAE J1939 data network.

The collision mitigation system is integrated with antilock brakes, as well as either a Roll Stability Control (RSC) or Electronic Stability Control (ESC) system. Antilock brakes keep wheels from locking up during emergency braking situations. An RSC system includes wheel speed sensors and a lateral accelerometer to determine critical rollover thresholds due to lateral forces. It reduces the throttle and applies engine and foundation brakes to rapidly decelerate the vehicle which helps prevent a potential rollover due to lateral instability. An ESC system includes wheel speed, yaw, steering angle, and control pressure sensors along with a lateral accelerometer to detect both lateral instability in potential rollover situations, as well as yaw instability in loss-of-control situations. ESC systems help prevent rollovers due to lateral instability in a similar manner as RSC systems. They also apply individual brakes that produce counter forces to improve vehicle directional stability and alignment.

## **Application**

Collision mitigation systems can help prevent or reduce the severity of many rear-end crashes involving commercial motor vehicles. Automatic foundation brake intervention distinguishes collision mitigation systems from existing "forward collision warning only" systems. If a pre-set safe following distance is compromised in a situation where a vehicle quickly decelerates or cuts in front of the truck, the collision mitigation system not only provides warnings to the driver, but it can initiate braking prior to any reaction from a driver. According to one manufacturer, its collision mitigation system's foundation brake deceleration may be up to one-third of a full brake application for the vehicle. This deceleration range is within safe limits for the driver to remain in control of the vehicle. When the driver does apply the brakes, he or she can then override the system.

A major advantage of collision mitigation systems is that they are fully integrated with anti-lock braking and stability control systems. These integrated safety systems have the capability of reducing rear-end, rollover, and loss of control crashes.

It is important to note that the effectiveness of a collision mitigation system, a stability control system, or a driver to decelerate a vehicle is still dependent on the load and other vehicle parameters, particularly brake and tire conditions. The condition and operation of the vehicle's brake system is critically important for proper operation of collision mitigation and stability control systems on commercial motor vehicles.

## **Operations and Benefits**

Collision mitigation systems can help prevent or mitigate rear-end crashes in situations where a commercial motor vehicle with the system is following another vehicle too closely or approaching a stopped or slower moving vehicle in front of it. (The systems will react to stopped vehicles and objects providing velocity of these vehicles and objects was previously detected.) They can be particularly advantageous for tractor-trailer combination vehicles, since they are typically more difficult to stop in a controlled manner than passenger cars and other single unit vehicles. These trucks can be 40 or more times heavier than the other vehicles in the traffic stream. They are less maneuverable, start more slowly, and take longer to stop.

Also, rear-end crashes are more likely to occur on divided highways and Interstates. In these settings,

drivers of both large trucks and other vehicles may not be able to respond quickly when a stopped or slower-moving vehicle suddenly appears in front of them. These factors affect the risk and results of rear-end crashes.

While automatic systems, such as collision mitigation systems and stability control systems can assist the driver in preventing potential crashes, the driver remains the most integral component in safely operating and maintaining the stability of the vehicle. These systems can assist a driver by providing deceleration prior to the driver being able to apply the brakes in emergency situations. The collision mitigation system's adaptive cruise control and automated braking help to ensure safer following distances and provide active braking, as needed in the situations described above. When integrated with anti-lock braking and stability control, collision mitigation systems can help a driver to stop more quickly and still maintain control of the vehicle during emergency braking situations.

## Costs

Collision mitigation systems can be installed by Original Equipment Manufacturers (OEMs) when the vehicles are manufactured. The cost of these systems is approximately \$2,500 over the costs of anti-lock braking systems and stability control systems, but the price can vary depending on the number of units acquired.

## Vendors

<p><b>Bendix Commercial Vehicle Systems LLC</b> 901 Cleveland Street Elyria, Ohio 44035 1-800-AIR-BRAKE (1-800-247-2725) <a href="http://www.bendix.com">www.bendix.com</a></p>	<p><b>Meritor WABCO</b> 2135 West Maple Road Troy, MI 48084-7121 Phone: 248-435-8001 Fax: 248-435-8002 <a href="http://www.meritorwabco.com">www.meritorwabco.com</a></p>
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