TRAFFIC SAFETY FACTS
Research Note

DOT HS 811 750

April 2013

Estimating Lives Saved by Electronic Stability Control, 2009-2011

Summary

In 2011, electronic stability control (ESC) saved an estimated 634 lives among passenger car (PC) occupants, and 411 lives among light truck and van (LTV) occupants, for a total of 1,045 lives saved among passenger vehicle (PV) occupants. This estimate of lives saved is a substantial increase over the estimated 876 lives saved in 2010 and the estimated 705 lives saved in 2009.

Introduction

NHTSA's National Center for Statistics and Analysis (NCSA) produces annual estimates of the number of lives saved by various occupant protection devices and laws. These estimates of the number of lives saved are produced in order to quantify the benefits of seat belts, frontal air bags, motorcycle helmets, child restraints, and minimum-legal-drinking-age laws.

In recent years, the percentage of passenger vehicles equipped with ESC systems has increased significantly. Federal Motor Vehicle Safety Standard (FMVSS) No. 126 was required to be in place and in force by September 1, 2011. As such, all new passenger cars, light trucks, SUVs, and vans must be equipped with ESC and comply with this standard. It is important to note that as the overall passenger vehicle fleet becomes more equipped with ESC, the lives-saved estimate will continue to rise. This report updates the progress and details the methodology for estimating the number of lives saved annually by ESC systems.

Figure 1 below shows the *percentage* of vehicles manufactured with ESC, by vehicle type (PC or LTV), and vehicle model year (MY 2005 through MY 2011). Figure 2 shows the *number* of vehicles manufactured with ESC, by these vehicle types and vehicle model years. Figure 1 shows that a higher percentage of LTVs have ESC compared to PCs, but both these percentages are approach-

ing 100 percent as manufacturers comply with FMVSS No. 126. The decline in LTVs manufactured with ESC, from 5.6 million in MY 2008 to 4.1 million in MY 2009, was due to the large reduction in overall vehicles manufactured in 2009 associated with economic factors. The penetration of ESC into the vehicle fleet can be best seen by combining the information from Figures 1 and 2. As more vehicles on the road are equipped with ESC, the number of lives saved by ESC will continue to increase. In 2011, approximately 55 million passenger vehicles of MY 2004 or later had ESC; this represents 23.1 percent of the 238 million passenger vehicles in the country in 2011. This estimate of 55 million vehicles with ESC does not account for two opposing trends for which data does not exist: the decrease due to vehicle attrition among ESC vehicles MY 2004 or later, and the increase that would be seen by including vehicles of MY 2003 or before that have ESC.

Figure 1

Percentage of Vehicles Manufactured With ESC, by Vehicle Type and Model Year
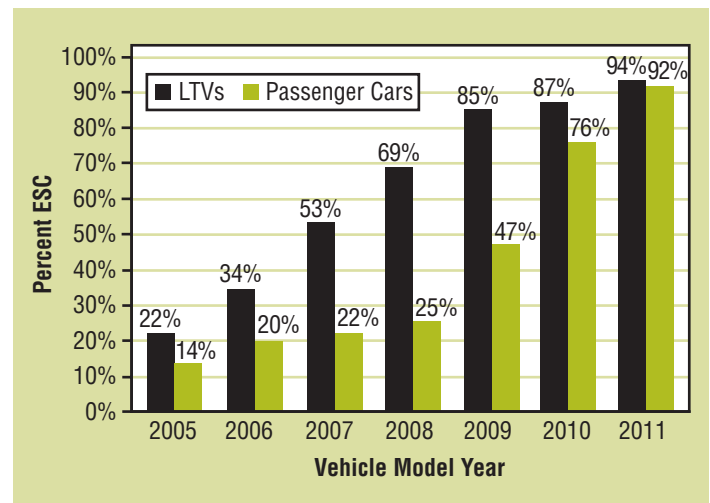
Source: Ward's Automotive Yearbook

Figure 2
Number of Vehicles Manufactured With ESC, by Vehicle Type and Model Year, in Millions
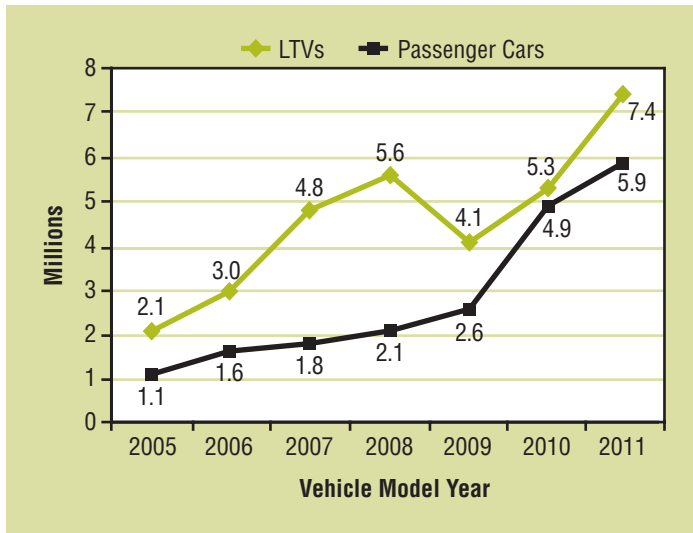
Source: Ward's Automotive Yearbook

Background

In August 2011, NHTSA published a report (DOT HS 811 486) titled "Crash Prevention Effectiveness of Light-Vehicle Electronic Stability Control: An Update of the 2007 NHTSA Evaluation" (Sivinski, 2011). This report states that the ESC technology is expected to reduce the number of crashes due to driver error and loss of control. ESC systems use automatic computer controlled braking of individual wheels to help the driver maintain control in risky driving situations in which the vehicle is beginning to lose directional stability at the rear wheels (spin out) or directional control at the front wheels (plow out). The largest benefit is focused on the reduction of single-vehicle crashes where a vehicle lost control and ran off the road.

Sivinski's report looked at NHTSA's Fatality Analysis Reporting System (FARS) data on fatal crashes in order to estimate the effectiveness of ESC. Only vehicle models that transitioned from "ESC not available" to "ESC standard" could be included in that report, which resulted in a small sample size. Effectiveness of ESC was measured by the difference in the ratio of crashes predicted to be affected by ESC (single-vehicle crashes, rollovers, etc.) to control crashes in vehicles with and without ESC. Control crashes were those in which a vehicle (1) was stopped, parked, backing up, or entering/leaving a parking space prior to the crash, or (2) traveled at a speed less than 10 mph, or (3) was struck in the rear by another vehicle, or (4) was a non-culpable party in a multivehicle crash on a dry road.

The report concluded that ESC effectiveness estimates are 55 percent for passenger cars and 50 percent for light trucks and vans. These estimates apply exclusively to fatal single-vehicle crashes that did not involve pedestrians, pedalcyclists, or animals in the first harmful event. This effectiveness estimate represents the decrease in probability that a vehicle is involved in a crash that results in a passenger fatality. Effectiveness estimates are also produced for seat belts, frontal air bags, and other devices and laws. For more information about how NHTSA produces lives saved estimates, refer to *Lives Saved FAQs*, published in December 2009 (www-nrd.nhtsa.dot.gov/Pubs/811105.PDF).

Methodology

To estimate the number of lives saved, the Insurance Institute for Highway Safety's (IIHS) list of ESC-equipped vehicles among vehicles of model year 1996 through 2012 was used to determine whether or not each make/model of vehicle in FARS data had (1) ESC standard, (2) ESC optional, or (3) ESC not available. The vehicle identification number (VIN) for each vehicle reported to FARS, in conjunction with the list of ESC-equipped vehicles, was used to determine whether the vehicle was ESC standard, where it was guaranteed to have ESC; or ESC optional, where manufacturers pre-selected which subset of these vehicles had ESC and which subset did not have ESC, thus giving the buyer an option of paying extra if they chose to purchase a vehicle with ESC; or ESC not available, where the vehicle did not have ESC. The lives-saved estimates in this report are limited to passenger vehicles that had ESC standard, and thus were known to have ESC in the vehicle. See the *Limitations* section of this report for more details.

A variable was established that showed which passenger vehicles were coded to have ESC standard (or not have ESC standard). This ESC variable was used to produce counts of ESC-equipped passenger vehicles in fatal crashes, and the fatality counts from occupants of those vehicles. The fatality counts in this report reflect occupant fatalities in passenger vehicles with ESC standard involved in single-vehicle crashes, from FARS 2009 and 2010 Final files, and FARS 2011 Annual Report File (ARF). The number of vehicles with ESC standard declines significantly among older model year vehicles. As more vehicles on the road are equipped with ESC, the number of lives saved by ESC will continue to increase. See Figures 1 and 2 above for information on the percentage and count of vehicles manufactured with ESC, for each model year of vehicles.

This report examines ESC in passenger cars, and light trucks and vans (sport utility vehicles, pickup trucks, and vans). These vehicle types when combined are referred to as passenger vehicles.

The following motor vehicle fatalities that occurred in 2011 were *not* used in producing the 2011 ESC lives saved estimates: single-vehicle fatalities in PVs that did not have ESC standard, multi-vehicle crash fatalities, motorcycle fatalities, large-truck fatalities, bus fatalities, pedestrian fatalities, and pedalcyclist fatalities. Single-vehicle fatalities that involved pedestrians, pedal-cyclists, or animals in the first harmful event are not included in the 2011 count of 930 single-vehicle crash fatalities in PVs with ESC standard, since the effectiveness estimates for ESC do not apply to these fatalities.

Results

In 2011, there were 21,253 PV occupant fatalities. Only 1,983 of these fatalities were in PVs with ESC standard. Those 1,983 fatalities include 930 fatalities in single-vehicle crashes and 1,053 fatalities in multivehicle crashes. The 930 single-vehicle fatalities in vehicles with ESC standard include 519 PC occupants and 411 LTV occupants. These 930 fatalities are used below to produce an estimate of lives saved by ESC in 2011.

The formula used to calculate the estimate of lives saved (LS) from ESC is dependent on (1) the number of single-vehicle crash fatalities (F) that did not involve pedestrians, pedalcyclists, or animals in the first harmful events, and (2) the effectiveness (E) of the ESC in the involved single-vehicle with ESC. This lives saved (LS) formula is: $LS = F * E / (1-E)$. The number of single-vehicle crash fatalities is stratified into two counts: PC occupants (519 in 2011) and LTV occupants (411 in 2011). The effectiveness of ESC that is inserted into this formula for lives saved is 0.55 for PC occupants and 0.50 for LTV occupants (Sivinski, 2011).

Table 1 below shows the lives saved estimates for PCs and LTVs equipped with ESC standard. In 2011, ESC saved an estimated 634 lives among passenger car occupants, and 411 lives among LTV occupants, for a total of 1,045 lives saved. These lives saved estimates were produced using the lives saved formula in the above paragraph, along with the fatality counts for the appropriate year. For example, a fatality count of 519 and an effectiveness of 0.55 were used to produce the lives saved estimate of 634 for passenger cars in 2011 [634 = 519*0.55 / (1-0.55)]. A fatality count of 411

and an effectiveness of 0.50 were used to produce the lives saved estimate of 411 for passenger cars in 2011 [411 = 411*0.50 / (1-0.50)].

This lives-saved estimate of 1,045 is a substantial increase over the 2010 estimate of 876 lives saved and the 2009 estimate of 705 lives saved, and the increase is correlated to an increase in the number of vehicles that were equipped with ESC standard. It is important to note that as the overall PV fleet becomes more equipped with ESC, then the lives saved estimates will continue to rise significantly.

The 2009 and 2010 lives saved estimates in this research note are produced using the FARS Final files for 2009 and 2010, while the 2011 lives saved estimates in this report are based on the 2011 FARS Annual Report file.

Table 1
ESC Lives Saved Estimates, by Year and Vehicle Type, 2009–2011

	Year	Passenger Cars With ESC Standard	Light Trucks/ Vans With ESC Standard	Passenger Vehicles With ESC Standard
ESC Lives Saved Estimates	2011	634	411	**1,045**
	2010	507	369	**876**
	2009	384	321	**705**

Source: NHTSA, NCSA, FARS 2011 ARF and FARS 2009-2010 Final File, IIHS
Note: Fatality counts used to estimate ESC lives saved are limited to single-vehicle crash fatalities, where the crash did not involve a pedestrian, pedalcyclist, or animal in the first harmful event.

Limitations

This section describes limitations regarding calculating estimates of the number of lives saved by ESC.

Limitation #1 - Some vehicle make/models have ESC standard, where all of those vehicles were manufactured with ESC, while others have ESC optional, where manufacturers pre-selected which subset of these vehicles had ESC and which subset did not have ESC, thus giving the buyer an option of paying extra if they chose to purchase a vehicle with ESC

In FARS single-vehicle crashes in 2011, a total of 930 fatalities occurred in vehicles that had ESC standard, while 1,219 fatalities occurred in vehicles that had ESC optional. Among passenger cars, 519 fatalities occurred in vehicles that had ESC standard and 804 in vehicles that had ESC optional, or 39 percent ESC standard. By comparison, among LTVs it was 411 ESC standard and

415 ESC optional, or 50 percent ESC standard. Sixty-six percent of the ESC optional fatalities occurred in passenger cars. Unfortunately, information is limited on which vehicles that were ESC optional had ESC installed on their vehicle.

The ESC lives saved estimates in this report are limited to vehicles with ESC standard, and thus the lives saved estimates are conservative. These estimates would rise if the number of vehicles with ESC was able to be determined exactly from the VIN; however, while the VIN contains much information about each vehicle, including vehicle make and model, unfortunately the VIN does not contain information on the status of ESC in a vehicle.

As the vehicle fleet becomes more equipped with ESC, the ESC lives saved estimates will continue to increase. This process will take 10 to 15 years before passenger vehicles with no ESC are rarely seen on America's roads.

Limitation #2 – In producing annual ESC lives saved estimates for this report, ESC effectiveness estimates were only used for the occupants of PC and LTV single-vehicle crashes, at the suggestion of NHTSA experts. Other ESC effectiveness estimates (i.e., multivehicle crashes, rollovers) were not used to produce ESC lives saved estimates, due to the smaller sample size that was available to produce these effectiveness estimates.

Limitation #3 - The effective estimates from Sivinski's report are based at the vehicle level, and not the person level. The lives-saved estimate made in this report assumes that an effectiveness estimate, such as 55 percent for passenger cars, based on reducing vehicle involvement in fatal crashes, can also be used in estimating a percent reduction in fatalities. All other NCSA effectiveness estimates are at the person level, such as seat belts, air bags, motorcycle helmets, child seats, and minimum legal drinking age. While this assumption seems logical, it still needs to be made.

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