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National Highway Traffic Safety Administration

TRAFFIC SAFETY FACTS
Research Note

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Estimating Lives Saved Annually by Electronic Stability Control

Summary

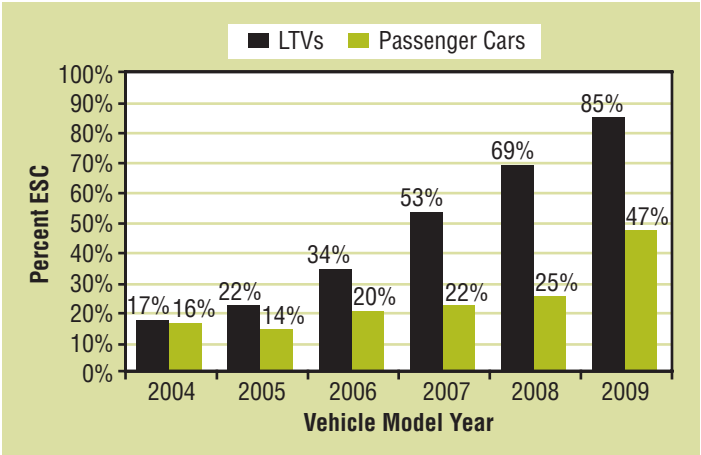
In 2009, electronic stability control (ESC) saved an estimated 373 lives among passenger car (PC) occupants, and 311 lives among light truck and van (LTV) occupants, for a total of 684 lives saved among passenger vehicle occupants. This lives-saved estimate is a substantial increase over the 2008 estimate of 620 lives saved and the 2007 estimate of 487 lives saved. 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, then the lives-saved estimate will continue to rise.

Introduction

NHTSA's National Center for Statistics and Analysis (NCSA) annually produces 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 assist in quantifying 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. As of September 1, 2011, all new PCs and LTVs must be equipped with ESC and comply with FMVSS No. 126. This report updates the progress and details the methodology for estimating the number of lives saved annually by ESC systems.

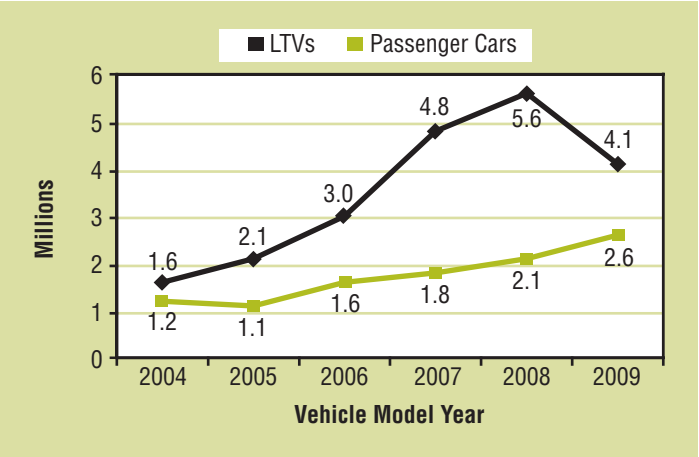
Figure 1 below shows the *percentage* of vehicles manufactured with ESC, by vehicle type (PC or LTV), and vehicle model year (MY 2004 through MY 2009). Figure 2 shows the *number* of vehicles manufactured with ESC, by these vehicle types and vehicle model years. Figure 1 shows that a higher percentage of LTVs have ESC compared to PCs, but both these percentages are rising rapidly as manufacturers respond to 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. By summing the data points, Figure 2 shows that in 2009 nearly 32 million passenger vehicles of MY 2004 or later had ESC; this represents 13 percent of the 242 million passenger vehicles in the country in 2009. This 32 million estimate of vehicles with ESC does not account for two opposing trends, 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
Percent 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 (Sivinski, 2011).

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 pedestrian, 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.

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 2009 was used to determine whether or not each make/model of vehicle in FARS data had (1) ESC standard, or (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 preselected 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 2007 and 2008 Final files, and FARS 2009 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, where LTV consist of sport utility vehicles, pickup trucks, and vans. PC and LTV, when combined, are referred to as passenger vehicles.

The following motor vehicle fatalities that occurred in 2009 were *not* used in producing the 2009 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. Two other single-vehicle fatalities that involved pedestrians, pedalcyclists, or animals in the first harmful event are not included in the count of 616 single-vehicle crash fatalities in PVs with ESC standard, since the effectiveness estimates for ESC do not apply to these fatalities.

Results

In 2009, there were 23,306 PV occupant fatalities. Only 1,257 of these fatalities were in PVs with ESC standard. Those 1,257 fatalities include 616 fatalities in single-vehicle crashes and 641 fatalities in multivehicle crashes. The 616 single-vehicle fatalities in vehicles with ESC standard include 305 PC occupants and 311 LTV occupants. These 616 fatalities are used below to produce an estimate of lives saved by ESC in 2009.

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: $LS = F \times E / (1 - E)$. The number of single-vehicle crash fatalities is stratified into two counts: PC occupants (305 in 2009) and LTV occupants (311 in 2009). 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 2009, ESC saved an estimated 373 lives among passenger car occupants, and 311 lives among LTV occupants, for a total of 684 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 305 and an effectiveness of 0.55 were used to produce the lives saved estimate of 373 for passenger cars in 2009 [$373 = 305 \times 0.55 / (1 - 0.55)$]. A fatality count of 311 and an effectiveness of 0.50 were used to produce the lives saved estimate of 311 for passenger cars in 2009 [$311 = 311 \times 0.50 / (1 - 0.50)$].

This lives-saved estimate of 684 is a substantial increase over the 2008 estimate of 620 lives saved and the 2007 estimate of 487 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.

Table 1
ESC Lives Saved Estimates, by Year and Vehicle Type, 2007–2009

	Year	Passenger Cars with ESC Standard	Light Trucks / Vans with ESC Standard	Passenger Vehicles with ESC Standard
ESC Lives Saved Estimates	2009	373	311	**684**
	2008	329	291	**620**
	2007	299	188	**487**

Source: NHTSA, NCSA, FARS 2009 ARF and FARS 2007–2008 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.

Table 2, on page 4, shows that in 2009, PV occupant fatalities in vehicles *with* ESC standard are less likely to be from single-vehicle crashes (49.0%) than PV occupant fatalities in vehicles *without* ESC standard (54.2%), by a difference of 5.2 percentage points (54.2 – 49.0 = 5.2). These percentages have varied over the period from 2005 through 2009. These results are displayed here because the effectiveness estimates of ESC discussed in this research note apply only to single-vehicle crashes, and not to multivehicle crashes.

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 2009, a total of 616 vehicles had ESC standard, while 1,126 had ESC optional. Among passenger cars, 305 had ESC standard

Table 2
Passenger Vehicle Occupant Fatalities, By ESC Status, Crash Type, and Year

	2005		2006		2007		2008		2009	
	#	%	#	%	#	%	#	%	#	%
ESC Standard										
Single-Vehicle Crashes	185	48.4	276	48.4	433	54.4	560	54.1	616	49.0
Multivehicle Crashes	197	51.6	294	51.6	363	45.6	476	45.9	641	51.0
Subtotal	**382**	**100**	**570**	**100**	**796**	**100**	**1,036**	**100**	**1,257**	**100**
Fatalities by Single and Multiple Vehicle Crashes with Model Year 1996-2009 which have Electronic Stability Control										
Not ESC Standard										
Single-Vehicle Crashes	15,616	50.3	15,484	51.6	14,701	52.2	13,177	54.2	11,946	54.2
Multivehicle Crashes	15,452	49.7	14,517	48.4	13,478	47.8	11,155	45.8	10,103	45.8
Subtotal	**31,068**	**100**	**30,001**	**100**	**28,179**	**100**	**24,332**	**100**	**22,049**	**100**
Total										
Single-Vehicle Crashes	15,801	50.2	15,760	51.6	15,134	52.2	13,737	54.2	12,562	53.9
Multivehicle Crashes	15,649	49.8	14,811	48.4	13,841	47.8	11,631	45.8	10,744	46.1
Total	**31,450**	**100**	**30,571**	**100**	**28,975**	**100**	**25,368**	**100**	**23,306**	**100**

Source: FARS 2005-2009 and IIHS
Note: These crashes did not involve pedestrians, pedalcyclists, or animals in the first harmful events.

and 728 had ESC optional, or 30 percent standard. By comparison, among LTVs it was 311 ESC standard and 398 ESC optional, or 44 percent ESC standard. Sixty-five percent of the ESC optional vehicles were 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 MLDA. While this assumption seems logical, it still needs to be made.

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This research note and other general information on highway traffic safety may be accessed by Internet users at: www-nrd.nhtsa.dot.gov/CATS/index.aspx