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Updated Estimates of Fatality Reduction by Curtain and Side Air Bags in Side Impacts and Preliminary Analyses of Rollover Curtains

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16. Abstract

Curtain and side air bags are designed to protect occupants in near-side impacts, those to the sides of vehicles adjacent to where the occupants are seated. Four major types of curtain and/or side air bags have been available in the United States since 1996. However, by model year 2011, 85 percent of new cars and LTVs (light trucks and vans) were equipped with curtains plus torso bags for drivers and right-front passengers. Curtains that deploy in rollover crashes began to appear in 2002; by 2011 about 45 percent of new cars and LTVs were equipped with such curtains. Logistic regression analyses of FARS data through calendar year 2011 show statistically significant fatality reductions for all four types of curtain and side air bags in near-side impacts for drivers and right-front passengers of cars and LTVs:

	Fatality Reduction (%)	Confidence Bounds
Curtains plus torso bags	31.3	25.0 to 37.1
Combination bag	24.8	17.7 to 31.2
Curtain only	16.4	3.0 to 28.0
Torso bag only	7.8	.4 to 14.7

Corresponding analyses of far-side impacts do not show corresponding, large benefits for curtain or side air bags. Curtains that deploy in rollover crashes show a statistically significant effect in first-event rollovers: The estimated fatality reduction is 41.3 percent (confidence bounds, 22.5 to 55.5%). Analyses should be repeated in about 3 or 4 years, when there will be considerably more data available.

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LIST OF ABBREVIATIONS

AIS	Abbreviated Injury Scale
BMW	Bayerische Motoren Werke
CDS	Crashworthiness Data System of NASS
CUV	crossover utility vehicle
CY	calendar year
DF	degrees of freedom
ESC	electronic stability control
FARS	Fatality Analysis Reporting System, a census of fatal crashes in the United States since 1975
GES	General Estimates System of NASS
IIHS	Insurance Institute for Highway Safety
LTV	light trucks and vans; includes pickup trucks, CUVs, SUVs, minivans, and full-size vans
MDB	moving deformable barrier
MY	model year
NASS	National Automotive Sampling System, a probability sample of police-reported crashes in the United States since 1979, investigated in detail
NCAP	New Car Assessment Program: ratings of new vehicles since 1979 based on performance in frontal impact tests
NHTSA	National Highway Traffic Safety Administration
RF	right-front seat
SAS	statistical and database management software produced by SAS Institute, Inc.
SUV	sport utility vehicle
TTI(d)	Thoracic Trauma Index measured on a dummy
VIN	Vehicle Identification Number

EXECUTIVE SUMMARY

A curtain or side air bag is designed to protect an occupant's head, torso, and/or pelvis in a side impact, specifically a "near-side" impact to the side of the vehicle adjacent to where the occupant is seated. While NHTSA has never explicitly required installation of curtain or side air bags, the agency encouraged it by listing, since 1996, the makes and models of vehicles that offer them in its *Buying a Safer Car* brochures and at www.safercar.gov; by expanding, in 1996, its NCAP consumer-information program to include star ratings for side impacts; and by upgrading, in 2007, FMVSS No. 214, "Side impact protection," adding an oblique 20 mph side impact test with a pole, with phase-in scheduled for MY 2011 to 2015. The agency anticipated that head-protection air bags would generally be installed to meet the new requirement.

Several types of side air bags have been offered in the United States, including torso bags that deploy from the seat or door (first sold on 1996 Volvos), head curtains that deploy down from the roof-rail area (first sold as an inflatable tubular structure in MY 1998 BMWs), and combination bags that deploy outward from the seat and then quickly upward to provide torso as well as head protection. However, by 2006, the clear preference was for separate curtain and torso bags, the configuration that covers the largest area and intuitively appears to provide the most protection. In model year 2011, 85 percent of new cars and LTVs were equipped with curtains plus torso bags for drivers and right-front passengers.

Meanwhile, some vehicles added rollover sensors that make it possible to also deploy the curtains in rollover crashes as well as side impacts (first sold on 2002 Ford Explorers and Mercury Mountaineers). In addition, recent curtains may cover a larger area and stay inflated longer to protect occupants in crashes with multiple impacts and to help prevent occupants' ejection from the vehicle in rollovers and other crashes. NHTSA anticipates curtains that deploy in rollovers will generally be used to meet FMVSS No. 226, "Ejection mitigation," which is scheduled to phase in from MY 2014 to 2017. Installations are catching up with the other types of side air bags; in model year 2011, 45 percent of new cars and LTVs were equipped with curtains that deploy in rollovers.

NHTSA issued a preliminary evaluation of side air bags in 2007, based on crash data through CY 2005 – before the widespread availability of separate curtain and torso bags. The analyses showed significant fatality reductions in near-side impacts for air bags offering head protection, but to do that the analyses had to merge curtain-plus-torso and combination bags into a single group with a single effectiveness estimate. NHTSA would now like to estimate the fatality reduction in near-side impacts specifically for curtain plus torso bags, as manufacturers are increasingly relying on this technology. Furthermore, the 2007 report had preliminary analyses, based on limited data, showing that curtain bags may be rather effective even for far-side occupants (e.g., the driver in a right-side impact); those analyses need to be revisited, as it is not intuitively clear why the technology would have a substantial effect in far-side impacts. The 2007 report did not study curtains that deploy in rollover crashes.

NHTSA's Fatality Analysis Reporting System through 2011 now has enough crash data to estimate individually the fatality-reducing effectiveness of each of the major types of curtain or side air bags in near-side impacts – including over 10 times as much data on vehicles with curtains plus torso bags as in the 2007 report. A logistic regression, comprising 73,228 FARS cases, found statistically significant fatality reductions for each type of curtain or side air bags, for drivers and RF passengers.

Estimated Fatality Reduction (%) in Near-Side Impacts, by Type of Side Air Bags

	Point Estimate	Confidence Bounds
Curtain plus torso	31.3	25.0 to 37.1
Combination	24.8	17.7 to 31.2
Curtain only	16.4	3.0 to 28.0
Torso only	7.8	.4 to 14.7

Separate curtain and torso bags show the highest effectiveness in near-side impacts: 31-percent fatality reduction, with relatively narrow confidence bounds from 25 to 37 percent. Supplementary contingency-table analyses of FARS and estimates of national fatality rates per 1,000 occupants involved in near-side impacts, based on FARS and NASS-GES data, confirmed the logistic regression's results for curtain plus torso bags. Effectiveness is approximately the same in cars and in LTVs, and for drivers and RF passengers.

Analyses for far-side impacts did not show corresponding, large benefits for curtain plus torso bags. Although some of the regressions show positive, but relatively small effects, NHTSA does not believe there is, on the whole, enough evidence to quantify a specific fatality reduction in far-side impacts at this point. The analyses of far-side impacts should perhaps be repeated in about 3 or 4 years, when there will be considerably more data available.

FARS now also has enough data for initial statistical analyses of curtains that deploy in rollover crashes. Although the data is still limited, it shows these curtains save lives in first-event rollovers. The estimated fatality reduction is a statistically significant 41.3 percent, with confidence bounds ranging from 22.5 to 55.5 percent. These curtains help prevent occupant ejection and also mitigate injuries from contact with components and surfaces inside the vehicle: they are about equally effective in reducing ejection and non-ejection fatalities in first-event rollovers. With the existing data, NHTSA did not see a fatality reduction in subsequent-event rollovers and also could not determine if the recent curtains that deploy in rollovers are more beneficial than earlier curtain designs in near-side or far-side impacts. These analyses, too, should be repeated in about 3 or 4 years.

1. Description, history, and previous studies of curtain and side air bags

1.1 Curtain and side air bags designed to deploy in side impacts

Curtain and side air bags are designed to protect an occupant's head, torso, and/or pelvis in a side impact, specifically a near-side impact to the side of the vehicle adjacent to where the occupant is seated. Some curtain air bags may also be designed to deploy in rollover crashes and/or to reduce an occupant's risk of complete or partial ejection from the vehicle in crashes; they are discussed in the next section. The analyses of this report are limited to air bags for front-seat occupants, where NHTSA has enough data for statistically meaningful results. In this report, air bags designed to deploy in side impacts are grouped into four major categories:

Torso air bags provide an energy-absorbing cushion between the occupant's torso and the vehicle's side structure during lateral impacts. They usually are built into the seat and deploy from there (Figure 1), but sometimes are built into the door (Figure 2). Some, but not all torso bags extend downward to also protect the pelvis (Figure 3).

Figure 1

Seat-Mounted Torso Bag

Figure 2

Door-Mounted Torso Bag

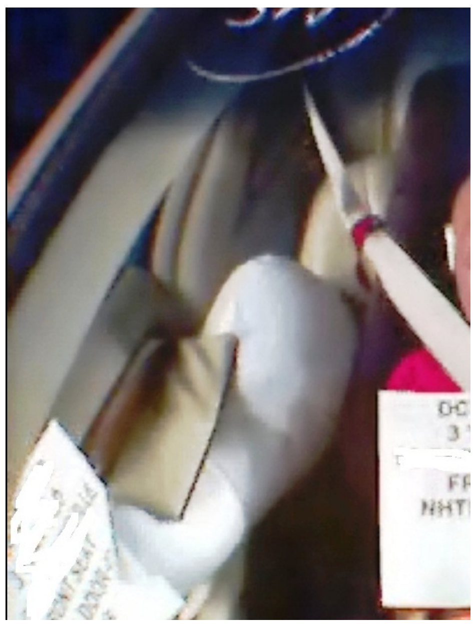
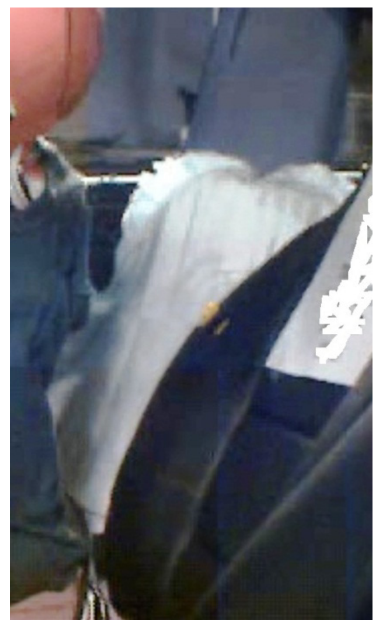


Figure 3

Torso Bag With Pelvis Protection



Curtain air bags are built into the roof-rail area above the side window and deploy downward to cover the window area. They provide a cushion between the occupant's head and some of the rigid surfaces of the vehicle interior, such as the roof rail, the window sill, the A-pillar, or the B-pillar. They might also prevent partial or complete ejection of the occupant through the side-window area and prevent direct occupant contact with the striking vehicle or object. Some early designs of curtain bags had a limited longitudinal span, leaving a substantial portion of the window uncovered (Figure 4) or were inflatable tubular structures with a limited vertical span (Figure 5).

Figure 4: Curtain Air Bag (Narrow Span)

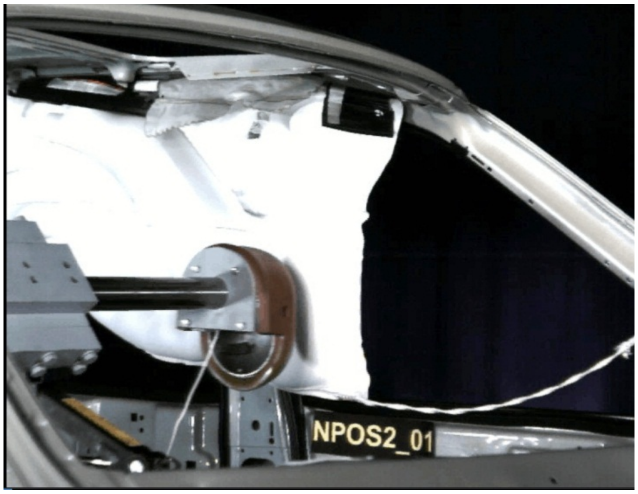


Figure 5: Inflatable Tube

Many recent curtains cover a wide longitudinal and vertical span, including most of the side-window area and the harder structures around it (Figure 6).

Combination bags are torso bags that deploy outward from the seat and then quickly upward to also provide head protection (Figure 7). Unlike curtains, they cover a somewhat limited area immediately to the occupant's side. Intuitively, they might not have as much effect as curtain air bags in preventing ejection or in an oblique lateral impact, i.e., if the occupant's trajectory is toward the front of the window area, which is not covered by the air bag. Shortly after 2000, a variety of models offered combination bags, but by the end of the decade they were limited primarily to convertibles, where there is no roof rail for installing a curtain air bag.

Figure 6: Curtain Air Bag (Wide Span)

Figure 7: Combination Bag

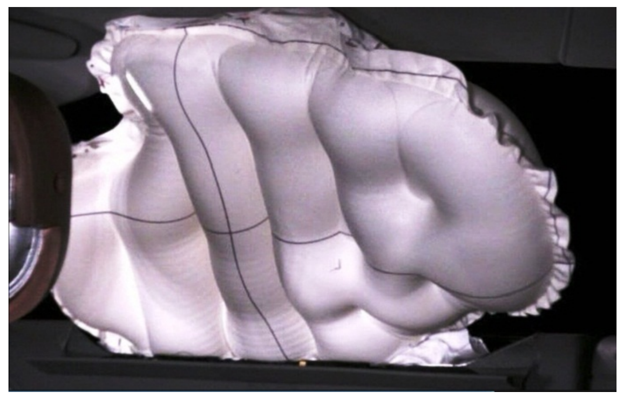
Curtain plus torso bags provide the most extensive side-impact protection. The curtains are separate from the torso bags, although they usually share components such as sensors and the control module (Figure 8). Recently, suppliers have developed a head-impact air bag for use in convertibles; it covers an area similar to a curtain, but deploys up from the door rather than down from the roof rail (Figure 9). Vehicles equipped with separate head-impact bags and torso bags are included with curtain plus torso bags in this report.

Figure 8

Curtain Plus Torso Bags

Figure 9

Door-Mounted Head-Impact Air Bag



1.2 Rollover curtains

Equipping a vehicle with a rollover sensor makes it possible to deploy the curtains in a first-event rollover and even in a post-impact rollover if the vehicle's electrical system is still functional after the initial impact. In addition, many recent curtains (often, but not necessarily always rollover curtains) may cover a larger area, horizontally and vertically than some earlier designs to protect occupants from contacts with a wider range of components and possibly to enhance performance in an oblique pole impact and/or an occupant containment test. Figures 4 and 5, for example, illustrate early curtain or tube designs covering a limited area, whereas the curtains in Figures 6 and 8 appear to cover the entire window and the rigid structures around the window.[1] A third feature of rollover curtains is that they remain inflated for some time after initial deployment – e.g., six seconds or more – to protect occupants in prolonged rollover events[2], cases with complex trajectories, or multiple crash events. The combination of rollover sensors, larger curtains, and prolonged inflation ought to reduce an occupant's risk of complete or partial ejection from the vehicle in rollover crashes – but it might also help prevent ejection in side impacts that are not rollovers and/or reduce injury risk from interior contacts in rollovers and side impacts.

[1] The curtain in Figure 8, although covering a large area, is not in a vehicle with rollover sensors.
[2] Investigations of vehicles without curtain air bags in rollover crashes that transverse long distances and many quarter turns often find that \ unbelted occupants were ejected at the end of the rollover sequences, \ thus, the need for rollover curtains to remain inflated for six seconds or more.

In theory, analyses could consider six categories of air bags – torso only, combination, non-rollover curtain only, rollover curtain only, non-rollover curtain plus torso, and rollover curtain plus torso – rather than just the four defined in Section 1.1. However, at the time of writing this report, the small numbers of cases with rollover curtains (with or without torso bags) and their concentration among certain vehicle types precludes that approach, as will be discussed in Section 1.6.

1.3 Relevant FMVSS and consumer information programs

No safety standard explicitly requires vehicles to have curtain or side air bags, but several FMVSS and a consumer-information program have implicitly prompted or encouraged their installation. NHTSA upgraded FMVSS No. 214, "Side impact protection," in 1990 with a phase-in scheduled for MY 1994 to 1997, to include a crash test in which a moving deformable barrier strikes the vehicle in the side. An injury criterion, the thoracic trauma index, is measured on a dummy seated near the impact location. Initially, manufacturers added structure or padding in or around the door to obtain TTI(d) scores low enough to meet the new standard. In late 1996, however, NHTSA expanded its New Car Assessment Program to include side impacts at speeds 5 mph faster than the test in FMVSS No. 214. Since torso air bags tend to substantially improve TTI(d) scores, the publication of NCAP star ratings for side impacts based to a large extent on TTI(d) may have been an incentive to expedite the introduction of torso bags in vehicles.[3]

NHTSA upgraded FMVSS No. 201, "Occupant protection in interior impact," in 1995, with a phase-in scheduled for MY 1999 to 2003, to reduce the risk of head injury from contact with the A-, B- and other pillars, the front and rear roof header, the roof side rails, and the upper roof.[4] Many of these injuries were happening in side impacts. Initially, most manufacturers added energy-absorbing materials in the target areas to meet the standard, but curtain bags were evidently a potential strategy for further reduction of head injuries. In fact, NHTSA modified some of the test procedures of FMVSS No. 201 in 1998 to facilitate introduction of head curtains.[5] The FMVSS No. 201 upgrade is a confounding effect in the analyses of this report, because injury reductions in side impacts due to the energy-absorbing materials pursuant to the upgrade should not be attributed to air bags.

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[3] Kahane, C. J. (2007, January). *An Evaluation of Side Impact Protection – FMVSS 214 TTI(d) Improvements and Side Air Bags*. (Report No. DOT HS 810 748, pp. 11-29). Washington, DC: National Highway Traffic Safety Administration. Available at www-nrd.nhtsa.dot.gov/Pubs/810748.PDF; *Federal Register* 55 (October 30, 1990): 45722.

[4] Kahane, C. J. (2011, November). *Evaluation of the 1999-2003 Head Impact Upgrade of FMVSS No. 201 – Upper-Interior Components: Effectiveness of Energy-Absorbing Materials Without Head-Protection Air Bags*. (Report No. DOT HS 811 538, pp. 1-17). Washington, DC: National Highway Traffic Safety Administration. Available at www-nrd.nhtsa.dot.gov/Pubs/811538.PDF; *Federal Register 60* (August 18, 1995): 43031.

[5] *Federal Register* 63 (August 4, 1998): 41451; soon after curtain bags first became available on some cars, NHTSA amended FMVSS No. 201 to facilitate their introduction on other vehicles. Recognizing that the 15 mph headform test might be a problem in target areas where the undeployed air bag is stored (and, furthermore, an inappropriate test if the bag usually deploys at that speed), NHTSA offered an alternative compliance procedure. Manufacturers have the option to reduce the speed of the headform test to 12 mph on target areas where the bag is stored, provided they can also meet an 18 mph lateral (90-degree) crash test for the full vehicle into a pole – with HIC < 1,000. The pole test simulates a head impact with the deployed bag.

In 2007, the agency further upgraded FMVSS No. 214 by adding a crash test of a 20 mph side impact with a pole, at a 75-degree angle (i.e., 15 degrees forward of a purely lateral impact).[6] The phase-in is scheduled for MY 2011 to 2015. NHTSA anticipated that head-protection air bags – i.e., curtain bags if possible; combination bags or door-mounted head-impact bags in convertibles without a roof rail – would generally be installed to meet the new requirement, because they appeared to be the principal technology available for cushioning an occupant in oblique impacts.

Finally, in 2011, NHTSA issued FMVSS No. 226, "Ejection mitigation," with a phase-in scheduled for MY 2014 to 2017.[7] The goal is to prevent the ejection of unrestrained occupants and the partial ejection of belted occupants in rollovers and other crashes. NHTSA anticipated that containment of the occupant would be achieved in many vehicles by a deployable ejection mitigation device – e.g., a curtain air bag that is designed to deploy in rollovers, stay inflated for six seconds, and be large enough to cover the window area and strong enough to contain the occupant. In other words, the new standard not only assumes many vehicles will have curtains or similar technology but is also likely influencing parameters such as the size of the curtains, when they deploy, and how long they stay inflated.

1.4 Installation history

Table 1 and Figure 10 show how installations of curtain or side air bags have increased from 0.3 percent of MY 1996 cars and LTVs involved in fatal crashes to almost 97 percent in MY 2011. The statistics are based on CY 1995 to 2011 FARS data and the VIN-decode programs derived from the information in Appendix A of this report. In other words, the statistics are for vehicles involved in fatal crashes and do not necessarily correspond to market shares. Volvo introduced torso bags in the United States, making them standard equipment on all their MY 1996 cars. Audi, BMW, and Cadillac began to furnish torso bags as standard equipment on some 1997 models and offer them as options on others. The first LTVs with standard torso bags were the 1998 Chevrolet Venture, Oldsmobile Silhouette, Pontiac Trans Sport vans and Mercedes SUVs. BMW introduced inflatable tubes for head protection, in combination with torso bags in their 1998 500-series and 700-series cars. In 1999, Mercedes E-series and Volvo S-80 were equipped with curtains plus torso bags. Head curtains alone, without torso bags, did not appear until MY 2001, as options in some Chrysler, Dodge, and Saturn cars. Combination bags were standard in 1999 on Lincoln Town Car and Continental and Infiniti Q45, G20, and QX4; also optional on some other Ford Motors cars and LTVs. Rollover curtains first appeared in 2002, as optional equipment on Ford Explorer and Mercury Mountaineer. Rollover curtains with torso bags were standard on Mercedes S-, CL-, and E-series cars, Volvo XC90, and Lexus LX in 2003 and optional on Toyota Landcruisers.

[6] *Federal Register* 72 (September 11, 2007): 51908.
[7] *Federal Register* 76 (January 19, 2011): 3212.

Table 1: Percent of Vehicles Equipped With Side Air Bags, by Model Year
(1995 to 2011 FARS data: vehicles involved in fatal crashes)

Model Year	No Air Bags	Torso Bags Only	Curtain Only			Combi-nation Bags	Curtain Plus Torso			All Rollover Curtains
			Non-Roll	Roll	Total		Non-Roll	Roll	Total	
1995	100.00	none	none	none	none	none	none	none	none	none
1996	99.73	0.27	none	none	none	none	none	none	none	none
1997	98.60	1.40	none	none	none	none	none	none	none	none
1998	94.58	5.19	none	none	none	none	0.23	none	0.23	none
1999	92.22	5.43	none	none	none	1.78	0.57	none	0.57	none
2000	85.03	9.70	none	none	none	4.43	0.84	none	0.84	none
2001	78.85	10.06	0.21	none	0.21	7.96	2.92	none	2.92	none
2002	72.75	14.99	1.06	0.50	1.56	6.89	3.81	none	3.81	0.50
2003	75.35	9.98	1.11	1.09	2.20	6.36	5.78	0.33	6.11	1.42
2004	72.45	8.33	2.66	1.11	3.77	5.69	8.84	0.91	9.75	2.02
2005	72.16	4.08	3.06	1.29	4.34	6.43	10.09	2.89	12.98	4.18
2006	63.51	2.51	4.40	1.66	6.06	5.28	16.82	5.83	22.65	7.49
2007	46.21	0.60	8.04	7.01	15.05	4.22	25.96	7.95	33.91	14.96
2008	32.23	0.32	7.07	8.17	15.24	4.35	35.10	12.76	47.86	20.93
2009	13.35	0.31	6.58	6.44	13.02	4.67	52.99	15.65	68.65	22.09
2010	4.91	0.05	6.43	4.12	10.55	4.21	49.10	31.18	80.28	35.30
2011	3.40	none	4.45	2.91	7.36	3.40	43.85	41.98	85.83	44.89

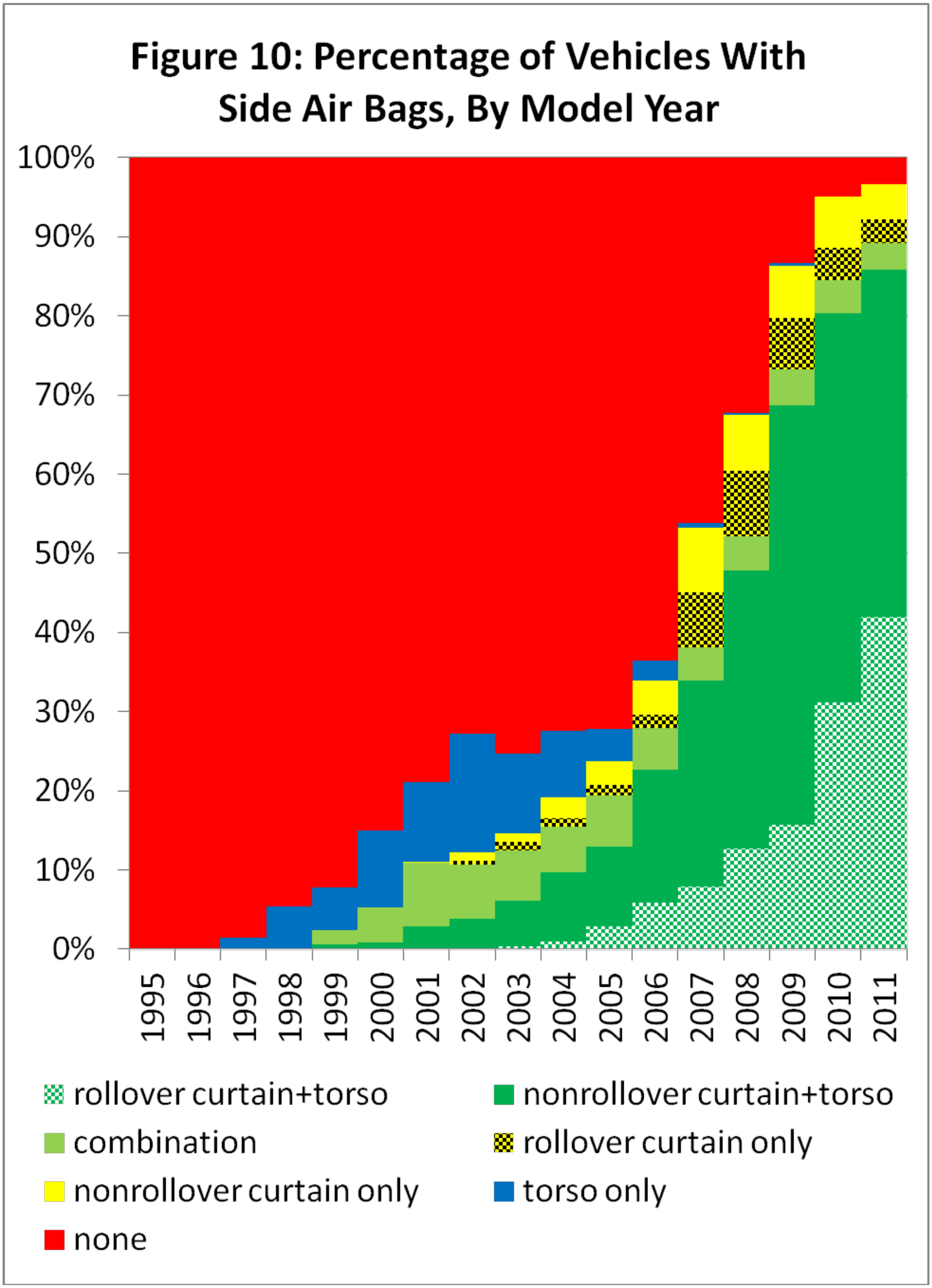

Figure 10: Percentage of Vehicles With Side Air Bags, By Model Year
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
rollover curtain+torso
nonrollover curtain+torso
combination
rollover curtain only
nonrollover curtain only
torso only
none

The big story in Table 1 and Figure 10 is the growing market share of curtain plus torso bags, from less than 1 percent in MY 2000 to nearly 86 percent in MY 2011, with most of the growth from 2005 to 2010.

Torso bags alone predominated in the early years, reaching a peak of 15 percent of MY 2002 vehicles. Thereafter, shares decreased as manufacturers added curtains, replaced the torso bag with a combination bag, or reduced torso bags from standard to optional equipment. Combination bags' highest share was 8 percent in 2001. At first, combination bags were available on a variety of convertibles, coupes, sedans, SUVs, CUVs, and minivans, but later they were increasingly limited to convertibles, where there is no roof rail to install curtains. In MY 2011, the joint share for curtain-plus-torso and combination bags was 89 percent, meaning that almost 90 percent of the new-vehicle fleet had some kind of head and torso protection. Head curtains alone were fairly common after 2005, reaching 15 percent of new-vehicles sales in MY 2007 and 2008, but then dropping back as manufacturers added torso bags. They were especially common in LTVs during those years.

Introduction of rollover curtains (with or without torso bags) has lagged about three years behind the introduction of curtain plus torso bags, not exceeding 10 percent of new vehicles until MY 2007. Rapid growth began in MY 2010, but that is too late to contribute large numbers of cases to the databases for this report (which go up to CY 2011). Furthermore, the trend to rollover curtains has been concentrated in CUVs and truck-based SUVs, slower in cars and pickup trucks.

1.5 Previous studies

NHTSA's 2007 evaluation report: The statistical analyses of side impacts in NHTSA's 2007 evaluation comprises FARS data on vehicles of MY 1994 (two years before the first side air bags) to 2003 in crashes of CY 1993 to 2005. The report does not address rollover curtains, which were just beginning to appear in those model years. A total of 1,503 front-seat occupant fatalities in near-side impact at seats equipped with curtain and/or side air bags were potentially available for analysis. A "near-side" impact is a left-side impact for the driver and a right-side impact for the right-front (RF) passenger (excluding some non-collision crashes and multiple impacts, as will be defined in the next section). The 1,503 cases were distributed by type of air bag and type of vehicle as shown in Table 2.

Table 2: Near-Side Fatality Cases Available for NHTSA's 2007 Report

	Curtain + Torso	Combo Bags	Curtain Only	Torso Only	Total
Cars	178	312	17	743	1,250
LTVs	2	69	10	172	253
Total	180	381	27	915	1,503

Nearly half of the available cases were passenger cars with torso bags only. There were relatively few LTVs with any type of air bag. Combinations bags were more than twice as common as separate curtain and torso bags (which, as Table 1 shows, were still not common as of MY 2003). There were hardly any cases of head curtains only. Given the limited data, most of the analyses in the 2007 report focused on passenger cars only and considered two air-bag configurations: (1) torso bags only; (2) combination or curtain + torso bags (i.e., torso bags plus some type of head protection) – the available data for both of these types together was somewhat more than half of the torso-only sample and it was sufficient for statistically meaningful results.[8] There were two analysis techniques, both limited to make-models that shifted directly from no air bags to a specific type of air bag (thus further cutting into the available data). One technique was to compare national fatality rates per 1,000 occupants involved in near-side impacts with and without the air bags, based on FARS data (fatalities) and NASS-GES data (crash-involved occupants). The other technique was contingency table analyses comparing near-side fatalities, with and without the air bags, to a control group of fatalities in longitudinal frontal or rear impacts (IMPACT2 = 12 or 6). The average fatality reduction for torso bags only in these analyses was 12 percent, while the average reduction for combination or curtain + torso bags was 24 percent. Those were the principal findings ("best estimates") of the 2007 report.[9] However, only the 24 percent reduction was statistically significant (barely) at the two-sided .05 level; the 12 percent reduction was not even borderline significant at the one-sided .05 level.[10]

One set of tables in the 2007 report separated combination and curtain + torso bags. "The … available data [does] not support a conclusion that one type of head protection is more effective than the other… We may assume, until more data become available, that both types of head protection are about equally effective [i.e., 24%] in near-side impacts."[11] Another table analyzed torso-bags-alone and torso-bags-plus-head protection in LTVs. "Both point estimates are quite close to our best point estimates of fatality reduction in passenger cars ….We may assume, until we obtain enough LTV data that would lead us to conclude otherwise, that side air bags are about as effective in near-side impacts for LTVs as for cars."[12] The data on vehicles with head curtains only was insufficient even for this level of analysis; instead, the report assumed that a head curtain alone was about as effective as a torso bag alone (12%), because the two together reduced fatalities by 24 percent and the effects were approximately additive.[13]

The 2007 report also analyzed far-side impacts (right-side impacts for drivers and left-side impacts for RF passengers).[14] The limited data on head curtains (with or without torso bags) in passenger cars showed substantial, statistically significant fatality reductions for unbelted occupants and for belted drivers when the RF seat is unoccupied. The rationale for a possible effect is that a curtain might cushion an occupant (especially if not belted and not blocked by other occupants) who gets across the seat and contacts interior surfaces on the far side. In fact, NASS-CDS data showed ample numbers of occupants with severe (AIS 4 to 6) injuries after their heads contacted surfaces on the far side of the vehicle.[15] However, NHTSA engineers and

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[8] Kahane (2007), pp. 82-104.
[9] Ibid., pp. 123-125.
[10] Ibid., footnote 189 on p. 123 and footnote 191 on p. 124; for significance testing at the two-sided .05 level, substitute 2.262 for 1.833 in the formulas.
[11] Ibid., pp. 100-102.
[12] Ibid., pp. 119-120.
[13] Ibid., pp. 121-123, 125, and 131.
[14] Ibid., pp. 105-117.
[15] Ibid., Table 3-24.

the peer reviewer Dainius Dalmotas doubted the high effectiveness numbers seen in the limited data, given that "specific mechanisms whereby side air bags mitigate injuries in far-side impacts [had] not [yet] been extensively demonstrated or quantified by testing." The report "assumed for the time being" a 24-percent effect for curtains in far-side impact (i.e., the same effect as for as for curtain plus torso bags in near-side impacts) and promised to update this estimate as more data accumulated.[16]

Padmanaban and Fitzgerald (2012) estimated the fatality reduction by rollover curtains for belted front-outboard occupants in single-vehicle crashes with first-event or subsequent rollover, based on FARS, NASS-GES and Polk data for CY 1999 to 2010 and MY 2000 to 2009. The analysis focused on make-models that shifted to rollover curtains as standard equipment. They found a statistically significant 23-percent fatality reduction for all belted occupants and a statistically significant 20-percent fatality reduction for non-ejected, belted occupants. The analysis is initial evidence that rollover curtains are effective in preventing ejection and also protecting occupants within the vehicle.[17]

1.6 Analysis outline

There are five compelling reasons for updating these evaluations of curtain and side air bags in side impacts and rollover curtains in rollover crashes:

- NHTSA would like a separate estimate, in near-side impacts, for curtain plus torso bags, which are by far the predominant configuration in recent vehicles, rather than a joint estimate with combination bags. The agency specifically desires this estimate for use in its upcoming report estimating lives saved by the FMVSS and other vehicle safety technologies through 2011.[18]
- The two principal estimates in the 2007 report are of limited statistical significance.
- Estimates for the configurations that were still not common as of MY 2003 were inferred rather than derived directly from the data.
- The analyses of far-side impacts, especially, need updating.
- Installation of rollover curtains greatly increased after MY 2009 (which was the last year in Padmanaban's analysis); a few more years of data might change the results.

It would be relatively straightforward if the analyses could consider six distinct categories of air bags – torso only, combination, non-rollover curtain only, rollover curtain only, non-rollover curtain plus torso, and rollover curtain plus torso – and that approach may be used in the future. But for now, in the FARS data available through CY 2011, only about 11 percent of the vehicles equipped with curtains (with or without torso bags) are equipped with rollover curtains; furthermore the vehicles with rollover curtains are not particularly representative of the vehicle

[16] Ibid., p. 117.
[17] Padmanaban, J., & Fitzgerald, M. (2012, September). Effectiveness of Rollover-Activated Side Curtain Airbags in Reducing Fatalities in Rollovers." *2012 IRCOBI Conference Proceedings*, pp. 76-90. Zürich: International Research Council on Biomechanics of Injury. Available at www.ircobi.org/downloads/irc12/pdf_files/16.pdf.
[18] Kahane, C. J. (2004, October). *Lives Saved by the Federal Motor Vehicle Safety Standards and Other Vehicle Safety Technologies, 1960-2002*. (Report No. DOT HS 809 833). Washington, DC: National Highway Traffic Safety Administration. Available at www-nrd.nhtsa.dot.gov/Pubs/809833.PDF.

fleet, but are concentrated among CUVs and truck-based SUVs. These conditions suggest a two-stage approach. First, relatively detailed analyses of the entire vehicle fleet will estimate fatality-reducing effectiveness in side impacts for the four types of curtain and side air bags defined in Section 1.1: torso only, combination, curtain only, and curtain plus torso. Chapter 2 presents the analyses for near-side impacts (e.g., left-side, for a driver) while Chapter 3 applies the same techniques to far-side impacts. Throughout these chapters, the reader should keep in mind that the curtain-only and curtain-plus-torso categories actually represent a mix of about 89-percent non-rollover curtains and 11-percent rollover curtains. Chapter 4 then runs through simpler, more preliminary analyses to determine if a rollover curtain reduces fatality risk in rollover crashes and/or if it enhances fatality reduction in near-side or far-side impacts; these analyses will be limited either to CUVs and truck-based SUVs (where most of the rollover curtains are) or to specific make-models that shifted to rollover curtains (similar to Padmanaban's approach).

2. Analyses of near-side impacts

2.1 Logistic regression analyses for near-side impacts

2.1.1 General description

As of July 2013, FARS data is available through CY 2011. The analyses of Chapters 2 and 3 of this report will include vehicles of MY 1994 (two years before the first side air bags) to 2011 in crashes of CY 1993 to 2011.

The predominant analysis technique in NHTSA's 2007 report was to measure the ratio of fatalities in near-side impacts to fatalities in control-group crashes (not mitigated by side air bags) in FARS data and to see if this ratio decreased with side air bags. In the 2007 report, the primary control group was longitudinal frontal or rear impacts (IMPACT2 = 12 or 6). It has two potential disadvantages:

- Gradual year-to-year improvements in frontal occupant protection could reduce the risk of a control group fatality and spuriously make it look that risk in near-side impacts is increasing.
- If FARS is not fully accurate in distinguishing whether a vehicle was struck in the side or in the front, there could be some "leakage" of near-side impacts into the control group or vice-versa, and that could lead to an underestimate of effectiveness.

One of the peer reviewers, Dainius Dalmotas, recommended instead a control group of non-occupant (pedestrian and bicyclist) fatalities in crashes involving these vehicles. These fatalities would not be affected by improvements in frontal occupant protection and it is most unlikely that FARS would classify a pedestrian fatality as a near-side occupant or vice-versa. In fact, the 2007 report already used the non-occupant control group for some of its analyses.[19] In this report, it will be the primary control group. The decision is prompted by the long range of model years in the analysis: a period of specific innovations in frontal occupant protection – pretensioners, load limiters, redesigned frontal air bags – and more gradual year-to-year improvements, such as those that resulted in the phase-out of poor and marginal performers on the IIHS offset-frontal test program. However, vehicles may also have become more pedestrian-friendly during those

[19] Ibid., pp. 90-91.

years, such as in the layout of under-hood components, but these improvements have probably not been as conspicuous as the progress in occupant protection. Given that no control group is perfect, this report will also, as a sensitivity test, include selected analyses with a control group of longitudinal frontal or rear impacts (IMPACT2 = 12 or 6), as in 2007.

The 2007 report relied primarily on contingency-table analyses. It created a list of make-models that shifted from no side air bags to a specific type of side air bag. For each model, the analysis included crash data for a limited span of model years before and after the transition to side air bags. The simple ratio of near-side to control-group fatalities was compared before and after the installation of side air bags. That approach can yield accurate effectiveness estimates if nothing else (besides the installation of side air bags) changes during that span of model years. The "all else stayed the same" assumption tended to break down after 2000 and especially after 2005 to a large extent because ESC, a technology that shifts the types of crashes vehicles get into, was often installed just before, just after, or even simultaneously with side or curtain air bags.

Logistic regression, on the other hand, permits estimating the effect of one factor (side air bags) even when other factors (ESC, for example) do not stay the same. ESC and other safety technologies can be control variables in the regression and their effects separated from the effect of the air bags. It is not necessary to exclude a model from the analysis because it received ESC at the same time as side air bags. It is also no longer necessary to limit the analysis to make-models that transitioned directly from no side air bags to a specific type or to limit the span of model years included. Because the analysis will now comprise a wide variety of makes and models, which may have different drivers and use patterns, the logistic regressions should also control for vehicle factors such as mass and footprint (a measure of a vehicle's size, roughly equal to the wheelbase times the average of the front and rear track widths), driver factors such as age and gender, environmental factors such as time of day and type of road, and secular factors such as the calendar year. All of these parameters might conceivably interact with the incidence of side impacts relative to pedestrian crashes. For example, pedestrian crashes are relatively less common on rural and high-speed roads.[20]

2.1.2 FARS database

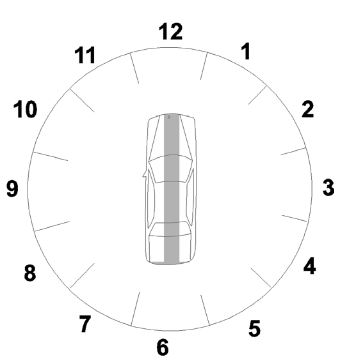
The presence and type of curtain or side air bags can usually be identified from the make-model and model year (if they were standard equipment) or from the first 12 characters of the VIN (if the VIN had a character that designated the type of bags, or if the bags were standard equipment only on some sub-series of the make-model). If the bags were optional but not identifiable by VIN, *Ward's Automotive Yearbooks*[21] specify the percentage of vehicles optionally equipped with the bags, by make, model, and model year. Appendix A lists all makes and models of cars and LTVs with dual air bags sold in MY 1996 to 2011, indicating for each MY the types of curtain or side air bags available, if any, and whether they were standard for the entire make-model, standard for certain VIN-identified subgroups, or, if they were optional and not VIN-identifiable, the percentage so equipped. There were no curtain or side air bags in the United

[20] In 2009 FARS, 62% of the occupant fatalities but only 28% of the pedestrian/bicyclist fatalities occurred on rural roads; 54% of the occupant fatalities but only 25% of the pedestrian/bicyclist fatalities occurred on roads with speed limit 55 mph or more.
[21] Southfield, MI: Penton Media, Inc.

States before 1996. The analysis database of 76,084 fatality cases includes every driver and RF passenger fatality in a near-side impact in cars and LTVs of MY 1994 to 2011 (i.e., dating back to two years before the first side air bags) in CY 1993 to 2011 plus every non-occupant fatality in CY 1993 to 2011 known to have been struck by a car or LTV of MY 1994 to 2011, subject to the following definitions and limitations:

- "Near-side" impacts exclude first-event rollovers and other non-collisions (HARM_EV = 1 to 6). They also exclude vehicles with the initial impact on the left side and the principal impact on the right side, or vice-versa. A driver fatality is in a near-side impact if IMPACT1 or IMPACT2 are 8, 9, 10, 61, 62, or 63. RF passenger fatalities are near-side if IMPACT1 or IMPACT2 are 2, 3, 4, 81, 82, or 83.[22] Note that post-impact rollovers are included if the crash is a near-side impact by this definition.
- Non-occupant fatalities include PER_TYP = 4 to 8 or 10 (primarily pedestrians, bicyclists and other cyclists, people riding on horses or in horse-drawn carriages, and people in wheelchairs, or on skates or other non-motorized devices). If there was only one vehicle in the crash, this is the vehicle that struck the non-occupant; if two or more, the VEH_NO of the vehicle that struck the non-occupant is identified by N_MOT_NO on the non-occupant's record in CY 1993-to-2010 FARS and by STR_VEH on 2011 FARS.
- In other words, the file comprises driver fatalities, RF passenger fatalities, and non-occupant fatalities.
- The make, model, and MY of the vehicle must be decodable from the first 12 characters of the VIN, using the VIN-decode programs developed by NHTSA's Evaluation Division.
- The vehicle driver's age and gender are known in FARS and the driver must be at least 14 years old. Note: this refers to the driver of the vehicle (who may be either a fatality or a survivor), not the fatally-injured RF passenger or non-occupant, who may be any age.
- The vehicle must be equipped with a frontal air bag and a 3-point belt (manual or automatic) at the driver's seat. Furthermore, if the case is a RF passenger fatality, the vehicle must also be equipped with a frontal air bag and a 3-point belt at the RF seat, but

[22] IMPACT1 is the initial impact and IMPACT2 is the principal impact. FARS has always used a clock schematic to indicate the damage location, with 12:00 corresponding to the front of the vehicle; thus, 2, 3, and 4 are right-side impacts and 8, 9, and 10 are left-side impacts. Starting in 2010, FARS added codes 61 to 63 and 81 to 83 for use if there is insufficient detail in the source material to readily identify a specific clock point: 61 = left side; 62 = left side, front half; 63 = left side, back half; 81 = right side; 82 = right side, front half; and 83 = right side, back half.



may not have a manual on-off switch for that air bag. However, the data includes unbelted as well as belted fatality cases.
- Vehicles of MY 1994 to 1996 that were not yet certified to the dynamic-test upgrade of FMVSS No. 214 are excluded.

The dependent variable in all regressions, NEARSIDE = 1 if the fatality case is a near-side occupant (regardless of whether it is a driver or a RF passenger) and = 2 if the fatality case is a non-occupant. The principal independent variables are the type of curtain and side air bags, if any, in the vehicle. There are several alternative ways to define them; they will be discussed with the individual regression analyses.

The other independent variables (control variables) to a large extent carry over from NHTSA's recent analyses of fatal-crash rates by vehicles' curb weight and footprint.[23] These variables, which comprise some key vehicle, driver, roadway, and environmental parameters, are:

ESC = 1 if the vehicle was equipped with ESC, = 0 if not equipped; if ESC was optional and not identifiable from the VIN, the variable is set to the value between 0 and 1 corresponding to the percentage equipped with ESC for that make-model in that MY (from *Ward's Automotive Yearbooks*). Note: for non-occupant fatality cases, this variable pertains to the vehicle that struck the non-occupant.

FMVSS201 = 1 if the vehicle certified to the head-impact upgrade of FMVSS 201, = 0 if it did not. FMVSS201 is always 0 if MY $\leq$ 1998 and always 1 if MY $\geq$ 2003.

FEMALE = 1 if the driver of the vehicle was female, = 0 if male. Note: for non-occupant and passenger fatality cases, this variable pertains to the gender of the driver of the vehicle, not the gender of the fatality case.

AGE14_25 = 25 minus the age of the driver of the vehicle if the driver is younger than 25, = 0 if the driver is 25 or older.

AGE50_96 = the age of the driver of the vehicle minus 50 if the driver is older than 50, = 0 if the driver is 50 or younger.

PICKUP, SUV, CUV, MINIVAN, BIGVAN: these dichotomous variables are set to 1 if the vehicle is a pickup truck, truck-based SUV, crossover utility vehicle, minivan, or full-size van, respectively. If the vehicle is a passenger car, all these variables are set to 0.

LBS100 = curb weight of the vehicle, in pounds, divided by 100

FOOTPRNT = footprint of the vehicle, in square feet. Footprint is the wheelbase times the average of the front and rear track widths.

[23] Kahane, C. J. (2012, August). *Relationships Between Fatality Risk, Mass, and Footprint in Model Year 2000-2007 Passenger Cars and LTVs*. (Report No. DOT HS 811 665, pp. 25-28 and 42-44). Washington, DC: National Highway Traffic Safety Administration. Available at www-nrd.nhtsa.dot.gov/Pubs/811665.PDF

NITE = 1 if the crash happened between 7:00 p.m. and 5:59 a.m. (i.e., HOUR = 0-5 or 19-24), = 0 if the crash happened between 6:00 a.m. – 6:59 p.m. (i.e., HOUR = 6-18).

RURAL = 1 if the crash happened in a county with population density < 250 per square mile, = 0 if the county's population density ≥ 250 per square mile.

SPDLIM55 = 1 if the crash happened on a road with speed limit 55, 60, 65, 70, 75, or 80; = 0 otherwise.

HIFAT_ST = 1 if the crash happened in a State with a higher-than-national-average overall fatality rate per million vehicle years in 2002 to 2008,[24] = 0 if the State had a lower-than-average fatality rate.[25]

VEHAGE = CY-MY, the age of the vehicle.

CYGP1, CYGP2, CYGP3, and CYGP5: calendar year groups. CYGP1 = 1 if CY ≤ 2000, = 0 otherwise; CYGP2 = 1 for CY from 2001 to 2003; CYGP3 = 1 for CY from 2004 to 2006; CYGP5 = 1 for CY from 2009 to 2011; if the crash occurred in 2007 or 2008, all of these variables are 0.

Table 3 shows that the current database has increased dramatically over what was available for NHTSA's 2007 report. The counts in Table 3 are limited to the database's near-side fatality cases in vehicles known to be equipped with a specific type of curtain and/or side air bags; they exclude vehicles with optional but not VIN-derivable air bags.

There are 10 times as many cases with curtain plus torso bags as in the 2007 report, an even larger increase for curtain only, triple for combination bags, and double for torso bags only. There are now far more cases with curtain plus torso bags – or with combination bags – than there were for both of these groups together in the 2007 report. The number of cases for LTVs has quadrupled and it is now almost as large as the sample size for cars in the 2007 report. The 1,871 curtain-plus-torso cases include 168 rollover curtains (141 in LTVs and just 27 in cars) and 1,703 non-rollover curtains. The 443 curtain-only cases include 80 rollover curtains (all in LTVs) and 363 non-rollover curtains. As stated above, the numbers of cases with rollover curtains are not yet sufficient for detailed, separate analyses.

[24] Alabama, Arizona, Arkansas, Colorado, District of Columbia, Florida, Georgia, Idaho, Kansas, Kentucky, Louisiana, Maine, Mississippi, Missouri, Montana, Nevada, New Mexico, North Carolina, Oklahoma, South Carolina, South Dakota, Tennessee, Texas, West Virginia and Wyoming.

[25] Alaska, California, Connecticut, Delaware, Hawaii, Illinois, Indiana, Iowa, Maryland, Massachusetts, Michigan, Minnesota, Nebraska, New Hampshire, New Jersey, New York, North Dakota, Ohio, Oregon, Pennsylvania, Rhode Island, Utah, Vermont, Virginia, Washington, and Wisconsin.

Table 3: Near-Side Fatality Cases Available for This Report and for the 2007 Report

	Curtain + Torso	Combo Bags	Curtain Only	Torso Only	Total
			THIS REPORT		
Cars	1,639	1,102	299	1,487	4,527
LTVs	232	214	144	457	1,047
Total	1,871	1,316	443	1,944	5,574
			2007 REPORT		
Cars	178	312	17	743	1,250
LTVs	2	69	10	172	253
Total	180	381	27	915	1,503

2.1.3 The principal regression analysis for near-side impacts

The main results of this report come from a single regression analysis that combines cars and LTVs. It is limited to vehicles whose status of curtain and/or side air bags was known with certainty, either because a single type was standard for the entire make-model in that MY or because the type could be decoded from the VIN for that specific vehicle; excluded are cases where the bags are optional but not decodable from the VIN. The regression model uses four dichotomous independent variables, CURT_TORS, COMBO, CURTAIN, and TORSO to indicate the type of air bags. If the vehicle does not have curtain or side air bags, all four are set to 0. Otherwise, just one of the variables is set to 1 and the other three set to 0. Specifically, if the vehicle has curtain plus torso bags, CURT_TORS = 1, but CURTAIN = 0 and TORSO = 0 (and, of course, COMBO = 0).[26] The values of the variables depend only on how the vehicle was equipped, regardless whether the air bags deployed or not (which, anyway, is often not reported in FARS).

Excluding the cases with non-decodable, optional air bags or with unknowns for any of the control variables, 73,228 fatality cases are available for the analysis, including 27,593 driver fatalities in near-side (i.e., left-side) impacts and 9,340 RF passenger fatalities in near-side (i.e., right-side) impacts, both of these groups treated identically as NEARSIDE = 1; and the control group of 36,295 non-occupant fatalities involving these vehicles, in which NEARSIDE = 2. (Section 2.1.2 explains what FARS cases are counted as near-side and non-occupant fatalities.)

A logistic-regression model estimates the logarithm of the odds of a failure (dependent variable = 1) to a non-failure (dependent variable = 2) as a linear function of the independent variables.

[26] There are a few make-models where, in some MY, the driver seat had a combination bag and the RF seat, torso only; in some others, a combination bag for the driver and no bag for the passenger. In the regressions, values of the air bag variables for the driver and non-occupant fatality cases are set according to the driver's bag; the values for the RF fatality cases, according to the RF passenger's bag.

Typically, a "failure" may be a subject who dies from an illness despite receiving a dose of some medicine, while a "non-failure" (success) would be a subject who survived the illness after such a dose of medicine. In this analysis, the "failures" are the fatality cases in near-side impacts (NEARSIDE = 1). Because non-occupants are a control group, each non-occupant fatality (NEARSIDE = 2) represents a unit of motoring exposure: the longer a person drives or rides in a vehicle, the more likely that, sooner or later, their vehicle could hit a pedestrian or bicyclist. Thus, the count of non-occupant fatalities involving a cohort of vehicles over a number of CY stands as a measure of the exposure of those vehicles. Each non-occupant fatality may be construed a "non-failure" for the purpose of the analysis in that it represents a unit of vehicle exposure without experiencing a near-side fatality. During the past decade, NHTSA has often performed similar logistic regressions where the dependent variable equaled 1 for crashes of interest and 2 for control-group crashes, construed as units of exposure.[27]

Here are the results from the SAS procedure, LOGISTIC:

```
The LOGISTIC Procedure

              Model Information

Data Set                      WORK.CHUCK3
Response Variable             NEARSIDE
Number of Response Levels     2
Model                         binary logit
Optimization Technique        Fisher's scoring


Number of Observations Read        73235
Number of Observations Used        73228
```

[27] See especially Kahane, C. J. (2003, October). *Vehicle Weight, Fatality Risk and Crash Compatibility of Model Year 1991-99 Passenger Cars and Light Trucks*. (Report No. DOT HS 809 662). Washington, DC: National Highway Traffic Safety Administration. Available at www-nrd.nhtsa.dot.gov/Pubs/809662.PDF; the three peer reviewers concurred with the logistic regression approach in that report (see Docket No. NHTSA-2003-16318-0004, available at www.regulations.gov); similar applications of logistic regression may be found, for example, in Dang, J. N. (2008, May). *Statistical Analysis of Alcohol-Related Driving Trends, 1982-2005*. (Report No. DOT HS 810 942). Washington, DC: National Highway Traffic Safety Administration. Available at www-nrd.nhtsa.dot.gov/Pubs/810942.PDF; Kahane, C. J. (2013, May). *Injury Vulnerability and Effectiveness of Occupant Protection Technologies for Older Occupants and Women*. (Report No. DOT HS 811 766). Washington, DC: National Highway Traffic Safety Administration. Available at www-nrd.nhtsa.dot.gov/Pubs/811766.PDF.

Response Profile

Ordered Value	NEARSIDE	Total Frequency
1	1	36933
2	2	36295

Probability modeled is NEARSIDE=1.

NOTE: 7 observations were deleted due to missing values for the response or explanatory variables.

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	101512.00	84402.923
SC	101521.21	84642.157
-2 Log L	101510.00	84350.923

R-Square   0.2089   Max-rescaled R-Square   0.2785

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	17159.0820	25	<.0001
Score	15509.0675	25	<.0001
Wald	12710.1600	25	<.0001

Analysis of Maximum Likelihood Estimates

Parameter	DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept	1	1.3128	0.0929	199.5308	<.0001
TORSO	1	-0.0815	0.0396	4.2425	0.0394
COMBO	1	-0.2844	0.0458	38.5803	<.0001
CURT_TORS	1	-0.3758	0.0451	69.2912	<.0001
CURTAIN	1	-0.1792	0.0761	5.5457	0.0185
ESC	1	-0.3690	0.0506	53.2088	<.0001
FMVSS201	1	-0.0610	0.0270	5.1037	0.0239
FEMALE	1	-0.0777	0.0183	18.1006	<.0001
AGE14_25	1	0.0916	0.00354	667.9656	<.0001
AGE50_96	1	0.0411	0.000975	1775.5116	<.0001
PICKUP	1	-0.9221	0.0328	790.0135	<.0001
SUV	1	-0.9536	0.0382	622.5045	<.0001
CUV	1	-0.7586	0.0521	211.8715	<.0001
MINIVAN	1	-0.7892	0.0395	398.9881	<.0001
BIGVAN	1	-1.5312	0.0658	542.3016	<.0001
LBS100	1	0.00846	0.00293	8.3016	0.0040
FOOTPRNT	1	-0.0377	0.00329	131.0467	<.0001
NITE	1	-0.6461	0.0175	1369.5062	<.0001
RURAL	1	0.5611	0.0181	962.7177	<.0001
SPDLIM55	1	0.9920	0.0182	2977.6811	<.0001
HIFAT_ST	1	0.1169	0.0171	46.7677	<.0001
VEHAGE	1	-0.00038	0.00401	0.0088	0.9253
CYGP1	1	-0.1241	0.0424	8.5654	0.0034
CYGP2	1	0.0153	0.0340	0.2016	0.6534
CYGP3	1	0.0878	0.0278	9.9590	0.0016
CYGP5	1	-0.0611	0.0280	4.7713	0.0289

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
TORSO	0.922	0.853	0.996
COMBO	0.752	0.688	0.823
CURT_TORS	0.687	0.629	0.750
CURTAIN	0.836	0.720	0.970
ESC	0.691	0.626	0.763
FMVSS201	0.941	0.892	0.992
FEMALE	0.925	0.893	0.959
AGE14_25	1.096	1.088	1.104
AGE50_96	1.042	1.040	1.044
PICKUP	0.398	0.373	0.424
SUV	0.385	0.358	0.415

CUV	0.468	0.423	0.519
MINIVAN	0.454	0.420	0.491
BIGVAN	0.216	0.190	0.246
LBS100	1.008	1.003	1.014
FOOTPRNT	0.963	0.957	0.969
NITE	0.524	0.506	0.542
RURAL	1.753	1.692	1.816
SPDLIM55	2.697	2.602	2.795
HIFAT_ST	1.124	1.087	1.162
VEHAGE	1.000	0.992	1.008
CYGP1	0.883	0.813	0.960
CYGP2	1.015	0.950	1.085
CYGP3	1.092	1.034	1.153
CYGP5	0.941	0.890	0.994

Association of Predicted Probabilities and Observed Responses

Percent Concordant	76.5	Somers' D	0.533
Percent Discordant	23.3	Gamma	0.534
Percent Tied	0.2	Tau-a	0.266
Pairs	1340483235	c	0.766

The section of the printout titled "Analysis of Maximum Likelihood Estimates" shows that **each** of the four types of curtain or side air bags **significantly reduced** fatality risk in near-side impacts relative to the control group of non-occupant fatalities. The regression coefficient for curtain plus torso bags, CURT_TORS is -.3758. Its standard error is .0451. The chi-square is 69.29 (chi-square must be at least 3.84 for statistical significance at the two-sided .05 level). Similarly, the regression coefficient for combination bags (COMBO) is -.2844, with chi-square 38.58, for curtains only (CURTAIN), -.1792 with chi-square 5.55, and for torso bags only (TORSO), -.0815 with chi-square 4.24.

The next section of the printout, "Odds Ratio Estimates" translates the coefficients and their standard errors into effectiveness estimates and their confidence bounds. The effectiveness is one minus the point estimate of the odds ratio and its confidence bounds are one minus the "95% Wald Confidence Limits" of the odds ratio. The odds ratio r is derived from the regression coefficient β by the formula $r = \exp(\beta)$. If s is the standard error of the regression coefficient, the confidence limits for the odds ratio are $\exp(\beta \pm 1.96\ s)$. Table 4 presents the main effectiveness estimates and their 95-percent confidence bounds.

Table 4

Estimated Overall Fatality Reduction (%) in Near-Side Impacts, by Type of Side Air Bags

	Point Estimate	Confidence Bounds Lower	Confidence Bounds Upper
Curtain + torso	31.3	25.0	37.1
Combination	24.8	17.7	31.2
Curtain only	16.4	3.0	28.0
Torso only	7.8	.4	14.7

Curtain plus torso bags reduce fatality risk in near-side impacts by an estimated **31.3 percent**. This is a fairly precise estimate, with 95-percent confidence bounds ranging from 25.0 to 37.1%. Actually, the estimate is based on a mix of primarily non-rollover curtain plus torso bags (1,703 near-side cases) and some rollover curtain plus torso bags (168 near-side cases). Chapter 4 will test whether the two sub-types of curtain plus torso bags are equally effective or not. Combination bags reduce fatality risk by **24.8 percent** (confidence bounds 17.7 to 31.2%). In other words, the 2007 report's single "best estimate" of 24-percent fatality reduction for the two types together underestimated the effect of curtain plus torso bags but was just about right on the combination bags. Curtain bags alone reduce risk by **16.4 percent** (confidence bounds 3.0 to 28.0%); torso bags alone by **7.8 percent** (confidence bounds 0.4 to 14.7%). Both of these estimates are still fairly close to the 2007 report's "best estimate" of 12-percent fatality reduction for the types together.

Almost all of the control variables had statistically significant associations with the dependent variable. ESC was associated with a significant reduction in near-side-impact fatalities (where it can help prevent the crash, especially the single-vehicle type) relative to pedestrian fatalities (where it has little preventive effect).[28] The head-impact upgrade of FMVSS No. 201 likewise reduced fatality risk in near-side impacts (where it mitigates head injuries) relative to pedestrian crashes (where no effect would be expected).[29] Female drivers have a slightly lower tendency than males to get into near-side impacts relative to pedestrian crashes. By contrast, young drivers and older drivers both tend strongly to be involved in near-side impacts relative to hitting pedestrians; the older drivers are also vulnerable to fatal injury in such impacts.[30] The five types of LTVs are all substantially less vulnerable than passenger cars in near-side impacts, thanks to factors such as greater width, more rigid structure, and/or higher sills.[31] The effect of curb weight is small, but in the direction of relatively more near-side impacts (or fewer pedestrian crashes) for heavier vehicles; it perhaps reflects the high rate of pedestrian crashes, at least in the past, for

[28] Sivinski, R. (2011, June). *Crash Prevention Effectiveness of Light-Vehicle Electronic Stability Control: An Update of the 2007 NHTSA Evaluation*. (Report No. DOT HS 811 468). Washington, DC: National Highway Traffic Safety Administration. Available at www-nrd.nhtsa.dot.gov/Pubs/811468.PDF.
[29] Kahane (2011, November).
[30] Kahane (2013, May).
[31] Kahane (2003, October), Chapter 6.

lighter cars.[32] Footprint's effect is in the opposite direction: fewer near-side impacts (or more pedestrian crashes) for larger vehicles. Perhaps increased width provides more space for the occupant and/or makes it more difficult to avoid hitting a pedestrian. The ratio of near-side impacts to pedestrian crashes is substantially lower at night, when pedestrians are more likely to be impaired and also harder to see. But it is substantially higher in rural areas, on high-speed roads, and in the States with high fatality rates (generally less urbanized); fewer people walk there. Vehicle age did not have a significant effect. Calendar year had small but significant effects: there were relatively fewer near-side impacts (more pedestrian crashes) from 1993 to 2000 and 2009 to 2011, but the opposite was true from 2001 to 2006.

The regression results also include overall "model fit statistics." The "max-rescaled R-square," which has approximately the same meaning as the R-square statistic for a linear regression, is .2785. "Testing global null hypothesis" finds that the likelihood-ratio chi-square for the model is 17,159 with 25 degrees of freedom, which is, of course, statistically significant at the .0001 level. In other words, the independent variables, as a group, have strong relationships with the dependent variable. Neither of these statistics sheds much light on how well the regressions are measuring the relationships between near-side fatality risk and curtain or side air bags; it is primarily the control variables with high chi-squares, such as AGE50_96, NITE, and SPDLIM55 that drive these statistics.

2.1.4 Alternative regression analyses

The following regression analyses for near-side fatalities relative use the same basic model as the principal regression but vary the classification of curtain and side air bags, the type of vehicles included, the control group, or whether to include optional air bags.

Aggregating curtain + torso with combination and curtain-only with torso-only: NHTSA's 2007 report obtained just two "best estimates": one for curtain + torso or combination bags (24% fatality reduction) and the other for curtain-only or torso-only (12% fatality reduction). The aggregation was necessary because there were so few vehicles with curtain bags at that time (alone or together with torso bags). The rationale was that protecting two body regions (head and torso) was approximately twice as beneficial as protecting just one (just the head or just the torso). Corresponding results may be obtained by running the same regression on the same data as in the preceding section, but instead of four separate independent variables for the four types of air bags, have just two. TWOREG (two body regions) = 1 if CURT_TORS=1 or COMBO = 1 in the previous regression. ONEREG (one body region) = 1 if CURTAIN = 1 or TORSO = 1 in that regression. The effectiveness estimate for TWOREG is 27.9 percent (confidence bounds, 22.9 to 32.6%). It is slightly higher than the 24 percent in the 2007 report, likely reflecting the higher proportion of curtain + torso bags (and relatively fewer combination bags) in the more recent vehicles. The effectiveness estimate for ONEREG is 9.1 percent (confidence bounds, 2.4 to 15.3%). That is close to the 12 percent in the 2007 report; moreover, it is statistically significant at the two-sided .05 level, unlike the estimate from the earlier report.

Separate analyses for cars and LTVs: The 73,228 fatality cases in the principal regression may be subdivided into 43,293 cases involving passenger cars and 29,935 involving any type of LTV.

[32] Ibid., p. xi.

In the regression for cars, the vehicle-type variables (PICKUP, SUV, CUV, MINIVAN, and BIGVAN) are omitted. In the LTV regression, PICKUP is omitted (and when the vehicle is a pickup truck, SUV, CUV, MINIVAN, and BIGVAN all equal 0). Table 5 compares the results for just cars and just LTVs.

Table 5: Estimated Fatality Reduction (%) in Near-Side Impacts
By Type of Side Air Bags and Vehicle Type

	Point Estimate	Confidence Bounds Lower	Upper
CURTAIN + TORSO			
Cars	30.0	22.8	36.6
LTVs	28.9	9.1	44.4
COMBINATION			
Cars	22.3	14.0	29.9
LTVs	27.6	11.8	40.7
CURTAIN ONLY			
Cars	2.1	- 20.2	20.3
LTVs	22.0	1.0	38.4
TORSO ONLY			
Cars	12.8	4.0	20.8
LTVs	8.7	- 4.7	20.3

Curtain plus torso bags are almost equally effective in cars (30%) and LTVs (28.9%), as are combination bags and torso bags. For curtain bags only, the point estimates show a larger difference between cars and LTVs, but for this type there is substantially less data than for the others, as shown in Table 3, and confidence bounds are correspondingly wider. Generally speaking, side air bags appear to be about equally effective in cars and LTVs. It seems appropriate to combine the car and LTV data for effectiveness estimates, as in the principal regression.

Analysis with near-side-impact cases limited to drivers: The principal analysis can be repeated, but omitting the 9,340 RF passenger fatalities in near-side (i.e., right-side) impacts. The independent variables stay the same, because the principal regression did not contain any marker to distinguish driver from RF passenger fatalities. Excluding the RF passengers perhaps has an advantage of making the database more uniform. Each of the four types of side air bags significantly reduces fatality risk for drivers. The estimated fatality reduction for curtain plus torso bags is 32.8 percent (confidence bounds, 25.9 to 39.0%); for combination bags, 21.5 percent (confidence bounds, 13.5 to 28.8%); for curtain only, 16.8 percent (confidence bounds, 2.0 to 19.4%); and for torso only, 10.4 percent (confidence bounds, 2.4 to 17.7%).

The coefficients for the drivers-only and the principal regressions may be used to infer a point estimate of effectiveness for RF passengers. Without side air bags, the FARS database includes 23,987 driver fatality cases in near-side impacts and 7,862 RF passenger fatalities, a ratio of 3.05 to 1, reflecting the fact that the RF seat is occupied approximately one-third of the time. If β is the regression coefficient from the principal regression and β_D is the coefficient for drivers only, the effectiveness for RF passengers may be estimated by

$$1 - \exp(4.05\beta - 3.05\beta_D)$$

Table 6 compares the results for drivers only and the inferred effectiveness for RF passengers to the average effectiveness for both groups combined.

Table 6: Estimated Fatality Reduction (%) in Near-Side Impacts
By Type of Side Air Bags and Seat Position

			Drivers plus RF	
	Drivers	RF Passengers	Point Estimate	Confidence Interval
Curtain + torso	32.8	26.6	31.3	(25.0 to 37.1)
Combination	21.5	33.8	24.8	(17.7 to 31.2)
Curtain only	16.8	15.2	16.4	(3.0 to 28.0)
Torso only	10.4	- .4	7.8	(.4 to 14.7)

Curtain plus torso bags and curtain-only show fairly similar results for drivers and RF passengers; both estimates are within the confidence interval of the principal regression result. Combination bags and torso bags show slightly larger differences between drivers and RF passengers, but no obvious pattern: a combination bag and a torso bag are fairly similar in design, yet effectiveness for RF passengers was high for the former and close to zero for the latter. The variation in the observed results may be due to limited data. On the whole, side air bags appear to be about equally effective for drivers and RF passengers. It seems appropriate to use the same effectiveness estimates for both seats, namely, the estimates from the principal regression.

Analysis including vehicles with optional, non-decodable bags: The four key independent variables, CURT_TORS, COMBO, CURTAIN, and TORSO are no longer dichotomous but may now also take values between 0 and 1. For the 73,228 cases in the principal regression – all vehicles with VIN-decodable air-bag status – they have the same value as before, always 0 or 1. However, for an additional 3,506 cases where the vehicle had optional, non-decodable air bags, these variables are set to the percentage of the vehicles of that make-model and MY equipped with that type of bag. For example, in the 2007 Jeep Compass (first entry in Appendix A), curtains were standard equipment and an unidentifiable 3 percent of the vehicles also had torso bags: CURT_TORS = .03, COMBO = 0, CURTAIN = .97, and TORSO = 0 for all 2007 Jeep Compass.[33]

Table 7: Estimated Fatality Reduction (%) in Near-Side Impacts
By Type of Side Air Bags in Two Regression Analyses

	Point Estimate	Confidence Bounds Lower	Confidence Bounds Upper
CURTAIN + TORSO			
Data includes non-decodable options	30.4	24.1	36.2
Data excludes non-decodable options	31.3	25.0	37.1
COMBINATION			
Data includes non-decodable options	23.2	16.1	29.7
Data excludes non-decodable options	24.8	17.7	31.2
CURTAIN ONLY			
Data includes non-decodable options	17.3	4.6	28.3
Data excludes non-decodable options	16.4	3.0	28.0
TORSO ONLY			
Data includes non-decodable options	8.5	1.3	15.1
Data excludes non-decodable options	7.8	.4	14.7

Table 7 indicates that the regression including the non-decodable options generates nearly the same estimates as the regression in Section 2.1.3. This is reassuring, although not surprising, given that the new analysis only added 3,506 cases to the 73,228 in the original database. The regression in Section 2.1.3, however, will remain the principal result, because NHTSA has more confidence in an analysis where the type of air bag is in each individual vehicle is known than in one where it is unknown for some of the vehicles.

Analysis with a control group of occupant fatalities in longitudinal impacts: The control group of non-occupant fatalities was chosen for the principal regression because there is no danger that crashes of interest (occupant fatalities) could be misclassified as control group cases (non-occupant fatalities) or vice-versa and because non-occupant fatalities have remained relatively stable over the years (see Section 2.1.1). However, the control group of driver and RF passenger fatalities in longitudinal impacts (12:00 or 6:00) might have compensatory advantages of (1) more FARS cases and (2) comparing occupant fatalities to occupant fatalities – thus, both

[33] In MY 2004-2006, Lincoln LS had standard combination bags and optional curtains (see Appendix A). For example, 21% of 2006 Lincoln LS were equipped with curtains. In this regression, all 2006 Lincoln LS have CURT_TORS=.21, COMBO=.79, CURTAIN=0, and TORSO=0 – i.e., curtain plus combination bags are considered equivalent to curtain plus torso bags.

the near-side impacts and the control group would reflect the factors that have made occupant fatalities generally trend downwards over the past two decades.

To keep potential misclassification of cases to a minimum, the analysis will exclude cases previously classified as near-side impacts if they also involved a frontal or rear impact – e.g., for a driver, if IMPACT1 is 8, 9, 10, 61, 62, or 63 but IMPACT2 is 1, 5, 6, 7, 11, or 12, or vice-versa. The control group is limited to purely longitudinal impacts: IMPACT1 is 6 or 12 and IMPACT2 is 6, 12, or unknown, or vice-versa. The regression is based on 103,283 FARS cases: 31,318 near-side impacts (a reduction from the 36,933 in the principal regression) and 71,965 longitudinal impacts (a large increase over the 36,295 control-group cases in the principal regression).

Table 8: Estimated Fatality Reduction (%) in Near-Side Impacts
By Type of Side Air Bags in Two Regression Analyses With Different Control Groups

	Point Estimate	Confidence Bounds	
		Lower	Upper
CURTAIN + TORSO			
Relative to longitudinal control group	31.1	25.6	36.2
Relative to non-occupant control group	31.3	25.0	37.1
COMBINATION			
Relative to longitudinal control group	21.3	15.1	27.0
Relative to non-occupant control group	24.8	17.7	31.2
CURTAIN ONLY			
Relative to longitudinal control group	14.3	3.0	24.4
Relative to non-occupant control group	16.4	3.0	28.0
TORSO ONLY			
Relative to longitudinal control group	9.5	3.5	15.2
Relative to non-occupant control group	7.8	.4	14.7

Table 8 indicates that the results with the control group of longitudinal impacts are nearly identical to the estimates based on the regression in Section 2.1.3. Even though the two alternative control groups have been subject to quite different trends over the past 20 years, the logistic regression models seem to have no trouble distinguishing the effect of curtain and side air bags in near-side impacts from the many other factors that affect fatality risk. This, too, is reassuring.

2.2 Contingency table analysis for curtain plus torso bags in near-side impacts

Logistic regression is the principal analysis method in this report because it permits estimating the effect of side air bags even when other vehicle factors, above all the availability of ESC, are also changing. However, the two simpler and more transparent methods of NHTSA's 2007 report can be used to check the regression-based estimates for curtain plus torso bags. One of them is contingency-table analysis for make-models that shifted from no side air bags to curtain plus torso bags and/or were simultaneously available without side air bags and with curtain plus torso bags, decodable from the VIN. Appendix B of this report lists the make-models considered eligible for the analysis and the time span of model years included. The vehicles had to meet the following criteria to be included:

- The database is limited to vehicles without side air bags (standard or VIN-identifiable) or with curtain plus torso bags (standard or VIN-identifiable);[34]
- Models are included for a range of at most six MY;
- Within the included range of MY, the annual percentages of vehicles equipped with ESC may not vary by more than 10 percentage points; and
- The range of MY included may be truncated or adjusted, if necessary, to "balance" the database to contain, in each make-model, approximately twice as many cases without any side air bags as cases with curtain plus torso bags. Balancing the database is important to avoid, for example, that most of the vehicles without air bags are small cars and most of those with the air bags are SUVs; if that were the case, the statistics might reflect the difference between small cars and SUVs rather than the effect of the air bags.

For the selected make-models and model years, the database contains the same types of fatality cases as the regression analyses: driver fatalities in near-side impacts, RF passenger fatalities in near-side impacts, and the non-occupant fatalities struck by these vehicles. Table 9 is a 2x2 table of near-side versus non-occupant fatalities, with and without curtain plus torso air bags.

Note that Table 9 includes only 493 near-side fatality cases with curtain plus torso bags, less than ¼ of the 1,871 in the regression analyses; many cases could not be used here because the make-model received ESC at or near the same time as the air bags, or because it was always produced with curtain plus torso bags, or because it shifted to curtain plus torso bags from some other type of side air bag. Nevertheless, there is enough data to show a clear reduction of near-side fatalities with curtain plus torso bags, relative to non-occupant cases. Chi-square for the table, depending on how it is measured, ranges from 14.87 to 15.16, in all cases well above the 3.84 needed for statistical significance at the two-sided .05 level. The estimate of fatality reduction – i.e., one minus the "Odds Ratio" in Table 9 – is 25.4 percent, with confidence bounds from 13.5 percent to 35.6 percent. Statistically speaking, this is similar to the result from the principal regression analysis, which was a 31.3 percent reduction with confidence bounds from 25.0 to 37.1 percent.

[34] Appendix B identifies a few make-models and MY in which small proportions (3 to 15%) of vehicles were equipped with some type of optional, non-identifiable side air bags; these are included in the group without side air bags.

Table 9: Contingency-Table Analysis of Fatality Reduction by
Curtain Plus Torso Bags in Near-Side Impacts (Non-Occupant Control Group)

Frequency Row Pct	NON-OCCUPANT	NEARSIDE	Total
NO SIDE AIR BAGS	1009 45.25	1221 54.75	2230
CURTAIN + TORSO	546 52.55	493 47.45	1039
Total	1555	1714	3269

Statistic	DF	Value	Prob
Chi-Square	1	15.1601	<.0001
Likelihood Ratio Chi-Square	1	15.1529	<.0001
Continuity Adj. Chi-Square	1	14.8687	0.0001
Mantel-Haenszel Chi-Square	1	15.1555	<.0001

Estimates of the Relative Risk (Row1/Row2)

Type of Study	Value	95% Confidence Limits	
Odds Ratio	0.7462	0.6438	0.8648

Table 10 is similar to Table 9, except that the control group consists of driver and RF passenger fatalities in longitudinal impacts (IMPACT1 is 6 or 12 and IMPACT2 is 6, 12, or unknown, or vice-versa). Also, the near-side impact cases in Table 9 where there was another impact in the front or rear of the vehicle are excluded. The results are quite similar to Table 9: an estimated fatality reduction of 25.0 percent for curtain plus torso bags (confidence bounds: 14.4 to 34.4%), chi-square ranging from 17.91 to 18.47.

Table 10: Contingency-Table Analysis of Fatality Reduction by
Curtain Plus Torso Bags in Near-Side Impacts (Control Group: Longitudinal Impacts)

Frequency Row Pct	12:00 OR 6:00	NEARSIDE	Total
NO SIDE AIR BAGS	2392 69.35	1057 30.65	3449
CURTAIN + TORSO	1247 75.12	413 24.88	1660
Total	3639	1470	5109

Statistic	DF	Value	Prob
Chi-Square	1	18.1863	<.0001
Likelihood Ratio Chi-Square	1	18.4737	<.0001
Continuity Adj. Chi-Square	1	17.9060	<.0001
Mantel-Haenszel Chi-Square	1	18.1828	<.0001

Estimates of the Relative Risk (Row1/Row2)

Type of Study	Value	95% Confidence Limits	
Odds Ratio	0.7495	0.6563	0.8559

2.3 FARS/GES analysis for curtain + torso bags in near-side impacts

The other method of NHTSA's 2007 report was to compare national fatality rates per 1,000 occupants involved in near-side impacts with and without the air bags, based on FARS data (census of fatalities in the United States) and NASS-GES data (national estimates of the numbers of crash-involved occupants derived from a probability sample of crash reports).[35] FARS data alone cannot provide national fatality rates per 1,000 crash-involved occupants because it is limited to crashes in which at least one person was a fatality. GES data alone can provide national fatality rates, but the rates would be imprecise because GES is only a sample of the nation's fatality cases. Thus, it is useful to combine FARS and GES for national estimates.

However, one issue with GES data is that the VIN is missing for 27 percent of the vehicle records in the calendar years of the database (as opposed to less than 3 percent missing in FARS). The remedy in the 2007 report was to limit the FARS/GES analysis to vehicles that shifted directly from no air bags of any type in one MY to standard air bags all of the same type in the next MY; that allowed using the make-model code on GES, which is only missing for 14 percent of cases. But only 8 of the 36 groups of make-models listed in Appendix B shifted from

[35] Kahane (2007), Tables 3-6 and 3-15.

no air bags at all to 100-percent curtain plus torso bags; the other 28 groups either shifted to or from a VIN-identifiable mix of air bags and no air bags, or a VIN-identifiable variety of air-bag types. There is little choice but to rely on the GES cases with VINs and assume, for this subsidiary analysis, that the reporting rates for VINs in GES is not confounded with the presence of side air bags in the vehicles.

Table 11 computes the fatality rates in near-side impacts for the make-models and MY ranges listed in Appendix B. The near-side fatality counts, 1,221 and 493, are identical to Table 9. When GES cases of drivers and RF passengers involved in near-side impacts are inflated to national totals by the WEIGHT variable on GES, there are an estimated 378,973 occupants without side air bags and 224,431 with curtain plus torso bags. The fatality rate dropped from 3.22 without the bags to 2.20 with curtain plus torso bags. The 31.8-percent fatality reduction in this analysis is very close to the 31.3 percent in the principal regression analysis.

Table 11: Fatalities Per 1,000 Drivers and RF Passengers in Near-Side Impacts
(1999-2011 FARS and GES data for make-models and MY listed in Appendix B)

	Near-Side Fatalities (FARS)	Near-Side Occupants (Weighted GES)	Fatality Rate	Fatality Reduction
Without side air bags	1,221	378,973	3.22	
With curtain plus torso bags	493	224,431	2.20	31.8 %

2.4 Conclusions: near-side impacts

All of the analyses of near-side impacts produce consistent results, indicating statistically significant overall fatality reductions for the four types of curtain and side air bags. The results of the principal regression analysis in Table 4 will serve as the “best estimates” of effectiveness, specifically that curtain plus torso bags reduce fatality risk by an estimated 31.3 percent. (The analyses of Section 4.5 will not show a consistently significant difference between rollover curtains and non-rollover curtains in near-side impacts, so the 31.3% estimate will, for now, apply to either type of curtains with torso bags.) Table 4 will supersede NHTSA’s 2007 report, which had estimated a 24-percent reduction for curtain-plus-torso or combination bags. NHTSA’s upcoming estimate of lives saved by FMVSS and vehicle safety technologies through 2011will use the fatality reductions in Table 4 for estimating lives saved by curtain or side air bags in near-side impacts.

3. Analyses of far-side impacts

NHTSA’s 2007 report analyzed far-side impacts (right-side for drivers, left-side for RF passengers) and found statistically significant fatality reductions with curtain plus torso bags: overall, especially for unbelted occupants and for belted drivers when the RF seat is unoccupied.[36] There was a non-significant fatality reduction with combination bags. FARS data

[36] Ibid., pp. 105-117.

on vehicles with curtain plus torso bags was still quite limited at that time. NHTSA engineers and the peer reviewer Dainius Dalmotas both doubted the relatively high effectiveness numbers based on limited data, given that "specific mechanisms whereby side air bags mitigate injuries in far-side impacts [had] not [yet] been extensively demonstrated or quantified by testing."[37] The great increase in FARS data on head curtains (with or without torso bags), since the 2007 report, as shown in Table 12, allows new analyses with perhaps more reliable results. Nevertheless, there are only about half as many fatalities in far-side impacts as in the more dangerous near-side impacts (see Table 3); that limits the potential for statistically conclusive results, even with the new data.

Table 12: Far-Side Fatality Cases Available for This Report and for the 2007 Report

	Curtain + Torso	Combo Bags	Curtain Only	Torso Only	Total
			THIS REPORT		
Cars	974	551	147	716	2,388
LTVs	113	122	75	260	570
Total	1,087	673	222	976	2,958
			2007 REPORT		
Cars	73	151	7	313	544
LTVs	3	39	10	101	153
Total	76	190	17	414	697

It is also conceivable that the effect of curtains in far-side impacts could change over time. A trend to curtains covering a larger area (see Section 1.2) might extend the range of contact points on the far side of the vehicle where the curtain might help. The shift to rollover curtains could help if the far-side impact is followed by rollover. However, the 1,087 curtain-plus-torso cases include only 93 rollover curtains and the 222 curtain-only cases include 27 rollover curtains; thus, the analyses results of this chapter will primarily reflect the non-rollover curtains.

The analyses of this report will not further subdivide the cases according to whether the driver was belted or accompanied by a RF passenger, as in the 2007 report. That is because most of the analyses will use a control group of non-occupant fatalities. The occupants of the striking vehicle in those pedestrian/bicyclist crashes are hardly ever fatalities; in fact, they would often be uninjured.[38] FARS data might not always accurately report the belt use of crash survivors[39] and,

[37] Ibid., pp. xiv and 117.
[38] For example, in 2009 crashes where vehicles struck and fatally injured pedestrians or bicyclists, only 0.26% of these drivers were fatally injured (possibly as a result of other crash events), 11% had nonfatal injuries, and the remainder were uninjured.

in some cases, might not even contain records of uninjured passengers.[40] Instead, the analyses of far-side impacts will consider all drivers and RF passengers, regardless of their belt use or how many people were in the vehicle. They are identical to the preceding analyses of near-side impacts, except the occupant-fatality cases will involve far-side rather than near-side impacts.

3.1 Logistic regression analyses for far-side impacts

The principal regression for far-side impacts uses the same independent variables as for near-side impacts, as discussed in Section 2.1.3. However, because far-side impacts are less often fatal than near-side impacts, there are only 55,456, not 73,228 data points available for the analysis: 15,933 driver fatalities in far-side (i.e., right-side) impacts and 3,228 RF passenger fatalities in far-side (i.e., left-side) impacts, both of these groups treated identically as FARSIDE = 1; and the same 36,295 non-occupant fatalities involving these vehicles as in the previous regression, in which FARSIDE = 2. Logistic regression estimates the log-odds that FARSIDE = 1 as a linear function of the independent variables. The effects of the control variables – the independent variables other than those pertaining to side air bags – are about the same as in the near-side regression, except that ESC and footprint have somewhat larger effects because many of the far-side impacts, especially those with fixed objects, are preceded by a loss of directional control; ESC and a large footprint both help maintain directional control.

Table 13, however, shows that curtain and side air bags are not nearly as influential in far-side as in near-side impacts. The first four rows of Table 13 derive from the principal regression analysis for far-side impacts: it generates coefficients for CURT_TORS, COMBO, CURTAIN, and TORSO, which are, in turn, transformed to odds ratios and effectiveness estimates with 95-percent confidence bounds. Only the coefficient for COMBO is statistically significant (χ^2 = 8.57), generating an effectiveness estimate of 15.0 percent, with confidence bounds from 5.2 to 23.7 percent. The estimates for curtain plus torso bags and curtain only are quite similar (9.7% and 12.3%); neither is significantly greater than zero. The estimate for torso bags alone is negative, but close to zero. The order of the estimates is not the intuitively expected one: curtains (with or without torso bags), which cover the widest potential impact area, might have been expected to show the largest effect in far-side impacts, where occupants might contact a wide variety of areas, depending on the direction of force and kinematics.

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[39] Kahane, C. J. (2000, December). *Fatality Reduction by Safety Belts for Front-Seat Occupants of Cars and Light Trucks: Updated and Expanded Estimates Based on 1986-99 FARS Data*. (Report No. DOT HS 809 199, pp. 2-3 and 10-19). Washington, DC: National Highway Traffic Safety Administration. Available at www-nrd.nhtsa.dot.gov/Pubs/809199.PDF

[40] Joksch, H. C. (1998, July). *Analysis of Unreported Right Front Seat Occupants in FARS and Their Influence on Air Bag Effectiveness Estimates*, (Report No. UMTRI-98-31). Ann Arbor: University of Michigan Transportation Research Institute. Available at deepblue.lib.umich.edu/bitstream/handle/2027.42/1250/92565.0001.001.pdf?sequence=2; Rice, T. M., & Anderson, C. L. (2009, February). The Effectiveness of Child Restraint Systems for Children Aged 3 Years or Younger During Motor Vehicle Collisions: 1996 to 2005. *American Journal of Public Health*, *99*, pp. 252-257. Available at www.ncbi.nlm.nih.gov/pmc/articles/PMC2622795/.

Table 13

Estimated Overall Fatality Reduction (%) in Far-Side Impacts, by Type of Side Air Bags

	Point Estimate	Confidence Bounds Lower	Upper
Curtain + torso	9.7	- .2	18.7
Combination	15.0	5.2	23.7
Curtain only	12.3	- 5.4	27.1
Torso only	- 4.9	- 15.2	4.5
Curtain (with or w/o torso)	10.3	1.1	18.6
Curtain or combination	12.3	5.2	18.9

A weakness of the initial regression is that it yields separate estimates for curtain plus torso and curtain only. Intuitively, in far-side impacts, the presence of the curtain would seem to be the key point, and the torso bag secondary (because occupants might impact far-side surfaces at a wide variety of locations, but the area covered by the torso bag is fairly limited).[41] It would be appropriate to obtain a single estimate for any system that includes a curtain, with or without the torso bag. That is accomplished by another regression, identical to the first one, except that the two variables CURT_TORS and CURTAIN are replaced by a single variable ANY_CURTAIN, which equals 1 if either of those variables equaled 1. The next-to-last row of Table 13 shows that the regression coefficient for ANY_CURTAIN does reach statistical significance ($\chi^2 = 4.72$) and that it generates a fatality reduction of 10.3 percent (but with fairly wide confidence bounds, 1.1 to 18.6%). Similarly, a third regression with a single variable ANY_HEAD_PROT replacing the three variables CURT_TORS, CURTAIN, and COMBO, generates a statistically significant coefficient ($\chi^2 = 10.90$) and an estimate that the availability of any air bag with head protection (curtain plus torso, curtain without torso, or combination) reduces fatality risk by 12.3 percent (confidence bounds, 5.2 to 18.9%).

All of these estimates, however, are lower than the 24 percent that was the preliminary conclusion of NHTSA's 2007 report. Furthermore, the estimates do not hold up that well for certain subsets of the database. For example, curtain bags might be expected to work better for drivers, who in the majority of vehicles do not have a passenger sitting between them and the right side of the vehicle, than for belted or unrestrained RF passengers, who always have a driver between themselves and the left side of the vehicle. But a regression limited to driver fatalities only generates a non-significant 7.9-percent fatality reduction for ANY_CURTAIN (confidence bounds -2.2 to +17.0%). Similarly, curtain bags might be expected to work best in passenger cars, which tend to be narrower than LTVs and have less distance between an occupant and the

[41] Kahane (2007), pp. 105-107.

far side of the vehicle. A regression limited to passenger cars, however, generates a non-significant 10.1-percent effectiveness for ANY_CURTAIN (confidence bounds -0.3 to +19.5%).

Performing similar regressions with the alternative control group of fatalities in longitudinal impacts (12:00 or 6:00) allows subdivision of the cases according to whether the driver was belted or accompanied by a RF passenger, as in the 2007 report. When the data are limited to unbelted, unaccompanied driver fatalities (in the far-side impacts and the control group), the regression coefficient for ANY_CURTAIN again reaches statistical significance ($\chi^2 = 4.39$) and the estimated fatality reduction is a somewhat higher 17.8 percent (but with wide confidence bounds, 1.3 to 31.6%).

3.2 Contingency table analysis for curtain + torso bags in far-side impacts

Table 14 is a 2x2 tabulation of driver and RF-passenger fatalities in far-side impact and non-occupant fatalities involving the make-models listed in Appendix B, which shifted from no side air bags to curtain plus torso bags and/or were simultaneously available without side air bags and with curtain plus torso bags, decodable from the VIN. Table 14 is identical to Table 9, except far-side impacts have replaced near-side impacts; in fact, the 1,552 non-occupant fatality cases are the same as in Table 9. Table 14 includes only 376 near-side fatality cases with curtain plus torso bags, as compared to 1,087 in the regression. That makes it less meaningful statistically, but it is still a useful check on the regression results.

In the near-side analysis, Table 9 showed a clear benefit for curtain plus torso bags, similar to the regression results. But Table 14 provides no encouragement that curtain plus torso bags are effective in far-side impacts. The estimate of fatality reduction – i.e., one minus the “Odds Ratio” – is -4.8 percent, with confidence bounds from -23.5 percent to +11.0 percent. Chi-square for the table, depending on how it is measured, ranges from .27 to .31, far less than the 3.84 needed for statistical significance at the two-sided .05 level.

Table 14: Contingency-Table Analysis of Fatality Reduction by
Curtain Plus Torso Bags in Far-side Impacts (Non-Occupant Control Group)

Frequency Row Pct	NON-OCCUPANT	FARSIDE	Total
NO SIDE AIR BAGS	1009 60.35	663 39.65	1672
CURTAIN + TORSO	546 59.22	376 40.78	922
Total	1555	1039	2594

Statistic	DF	Value	Prob
Chi-Square	1	0.3148	0.5747
Likelihood Ratio Chi-Square	1	0.3145	0.5749
Continuity Adj. Chi-Square	1	0.2696	0.6036
Mantel-Haenszel Chi-Square	1	0.3147	0.5748

Estimates of the Relative Risk (Row1/Row2)

Type of Study	Value	95% Confidence Limits	
Odds Ratio	1.0480	0.8896	1.2346

Similarly, a contingency table analysis with the alternative control group of fatalities in longitudinal impacts, limited to unbelted, unaccompanied driver fatalities shows zero effect for curtain plus torso bags in far-side impacts.

3.3 FARS/GES analysis for curtain + torso bags in far-side impacts

Table 15 computes the fatality rates per 1,000 crash-involved occupants in far-side impacts for the make-models and MY ranges listed in Appendix B, using FARS data to count the fatalities and weighted NASS-GES data for national estimates of the numbers of crash-involved occupants. Table 15 is identical to Table 11, except far-side impacts have replaced near-side impacts.

Table 15: Fatalities Per 1,000 Drivers and RF Passengers in Far-Side Impacts
(1999-2011 FARS and GES data for make-models and MY listed in Appendix B)

	Far-side Fatalities (FARS)	Far-side Occupants (Weighted GES)	Fatality Rate	Fatality Reduction
Without side air bags	663	370,709	1.79	
With curtain plus torso bags	376	217,808	1.73	3.5 %

Table 15 provides little encouragement that curtain plus torso bags are effective in far-side impacts. The fatality rate per 1,000 occupants is nearly the same with curtain plus torso bags (1.73) as without them (1.79): only a 3.5-percent reduction. By contrast, Table 11 showed a 31.8-percent fatality reduction for curtain plus torso bags in near-side impacts.

3.4 Discussion: far-side impacts

The analyses of curtain air bags in far-side impacts (specifically, a mix of approximately 10% rollover curtains and 90% non-rollover curtains) are not conclusive – except to the extent that fatality reduction is likely not as high as 24 percent, the preliminary conclusion of NHTSA's 2007 report. Regressions generally show positive point estimates for air bags with head protection (curtain plus torso, curtain alone, or combination). Pooling the various types of air bags (by defining the variables ANY_CURTAIN or ANY_HEAD_PROT) can even generate estimates of fatality reduction that reach statistical significance. But there are many questions: why are the point estimates for combination bags, which cover a smaller area, higher than for curtains? Why aren't curtains more effective for drivers (who often sit alone) than for RF passengers? Why aren't they more effective in cars (which tend to be narrower) than in LTVs? Furthermore, while the contingency-table and FARS-GES analyses are based on less data and not as statistically meaningful as the regressions, they should ideally provide at least some support for the regression results, but they do not: they yield near-zero effectiveness estimates for curtain plus torso bags in far-side impacts.

Another question is whether the effect, if any, is different for rollover curtains and non-rollover curtains. The preliminary analyses in Section 4.6 will address, but not fully answer it. The report's conclusions on far-side impacts will follow those analyses.

4. Preliminary analyses of rollover curtains

Rollover curtains first appeared in MY 2002, as optional equipment on Ford Explorer and Mercury Mountaineer. Introduction of rollover curtains has lagged several years behind the other air bag technologies. It did not exceed 10 percent of new vehicles until MY 2007; rapid growth began only in MY 2010. Appendix A specifies when and if each make-model received rollover curtains. There are numerous make-models, such as Jeep Compass, whose curtains were equipped with rollover sensors from the start. Some of these models never existed without curtains (Jeep Compass); others shifted to rollover curtains from previously having no air bags

(Hummer H2), from torso bags only (Acura MDX), or from combination bags (Lincoln Navigator). Many other models, such as Jeep Grand Cherokee, already had non-rollover curtains and later switched to rollover curtains. In these cases, it is unknown if the switch to rollover curtains consisted merely of adding rollover sensors or if other parameters also changed, such as the size of the curtain and the time it stays inflated. The current small number of cases with rollover curtains and the variety of ways they were introduced complicate the analyses to some extent. The data situation will improve in a few years, because many vehicles have been equipped with rollover curtains starting in MY 2010.

4.1 Logistic regression analyses for first-event rollovers

A basic evaluation question is whether rollover curtains have significantly reduced overall fatality risk in first-event rollover crashes. The primary analysis technique is a logistic regression of rollover fatalities relative to a control group of non-occupant fatalities, similar to the principal regression for near-side impacts in Section 2.1.3, except modified to focus on rollover curtains and rollover crashes.

In this report, "first-event rollovers" are single-vehicle crashes (VE_FORMS = 1), including not only those where FARS says the first harmful event was a rollover (HARM_EV = 1), but also if FARS says the most harmful event was a rollover (M_HARM = 1) and the first "harmful" event was basically a tripping mechanism such as a curb or ditch.[42] As in Section 2.1.3, the database is limited to driver and RF passenger fatalities in the crashes of interest (first-event rollovers in this case) and control-group fatalities, namely non-occupants (PER_TYP = 4 to 8 or 10). The make, model, and MY of the vehicle that rolled over or struck the non-occupant must be decodable from the VIN; FARS must report the age (at least 14) and gender of the driver of that vehicle.

Because rollover curtains did not appear until MY 2002, the database will start at MY 2000 (two years before the first rollover curtains) and CY 1999 and run to MY and CY 2011: a later start by six years than in Section 2.1.3. Table 16 shows the distribution of rollover fatalities, with and without rollover curtains, by vehicle type. There are 150 cases of rollover fatalities with rollover curtains and 130 of them are CUVs or truck-based SUVs. Furthermore, those are the only two vehicle types where more than 1 percent of the vehicles with rollover fatalities were equipped with rollover curtains. It is appropriate to further limit the database to the CUVs and truck-based SUVs: only a small proportion of the cases with rollover curtains are lost, and it eliminates data on vehicle types where there are hardly any rollover curtains to date.

[42] HARM_EV = 33 (curb), 34 (ditch), 38 (fence), 41 (shrubbery), 44 (pavement surface irregularity), 48 (snow bank), 53 (mail box), 54 (objects fallen from another vehicle), 59 (milepost, etc.), or 72 (cargo loss or shift).

Table 16: Fatalities in First-Event Rollovers, by Vehicle Type
(FARS, CY 1999 to 2011, MY 2000 to 2011)

	No Rollover Curtain		Rollover Curtain	
	N	%	N	%
Cars	4,543	99.87	6	.13
Pickup trucks	4,197	99.71	12	.29
CUVs	566	94.18	35	5.82
Truck-based SUVs	4,105	97.74	95	2.26
Minivans	297	99.93	2	.67
Full-size vans	150	100.	0	.0

The dependent variable in the regressions, ROLL1 = 1 if the fatality case is an occupant in a first-event rollover (regardless of whether it is a driver or a RF passenger) and = 2 if the fatality case is a non-occupant. The principal independent variables ROLLCURT = 1 if the vehicle is equipped with rollover curtains at the front seats and = 0 otherwise. Variables denoting the other types of side air bags (e.g., TORSO, COMBO, CURTAIN, and CURT_TORS) are unnecessary, because air bags that are not designed to deploy in rollovers are not likely to have much effect in a first-event rollover. The other independent variables (control variables) are identical to the regression in Section 2.1.3, with two exceptions: (1) Because there are only two vehicle types, only one variable is necessary to denote the vehicle type; CUV = 0 if the vehicle is a truck-based SUV; CUV = 1 if the vehicle is a CUV; (2) Because there are no cases before CY 1999, it is possible to drop CYGP1 and redefine CYGP2 = 1 for CY from 1999 to 2003. The FMVSS201 control variable is important because the energy-absorbing materials used to meet FMVSS No. 201 are especially effective in reducing head injuries in first-event rollovers.[43]

Excluding the cases with non-decodable, optional rollover curtains or with unknowns for any of the control variables, 9,550 fatality cases are available for the analysis, including 3,631 driver fatalities in first-event rollovers and 1,170 RF passenger fatalities in first-event rollovers, both of these groups treated identically as ROLL1 = 1; and 4,749 non-occupant fatalities involving these vehicles, in which ROLL1 = 2. Logistic regression estimates the log-odds that ROLL1 = 1 as a linear function of the independent variables. Here are the results from the SAS procedure, LOGISTIC:

```
The LOGISTIC Procedure

              Model Information

Data Set                        WORK.ZEPPY12
Response Variable               ROLL1
Number of Response Levels       2
Model                           binary logit
Optimization Technique          Fisher's scoring
```

[43] Kahane (2011), Tables 2-3 and 3-3.

Number of Observations Read	9550
Number of Observations Used	9550

Response Profile

Ordered Value	ROLL1	Total Frequency
1	1	4801
2	2	4749

Probability modeled is ROLL1=1.

Model Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Intercept Only	Intercept and Covariates
AIC	13240.828	8660.981
SC	13247.992	8789.938
-2 Log L	13238.828	8624.981

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	4613.8471	17	<.0001
Score	3876.9338	17	<.0001
Wald	2623.8732	17	<.0001

Analysis of Maximum Likelihood Estimates

Parameter	DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept	1	-0.2285	0.2744	0.6937	0.4049
ROLLCURT	1	-0.5321	0.1414	14.1538	0.0002
ESC	1	-1.1356	0.1129	101.1677	<.0001
FMVSS201	1	-0.1972	0.0728	7.3451	0.0067
FEMALE	1	-0.2171	0.0558	15.1151	0.0001
AGE14_25	1	0.1466	0.0123	141.8258	<.0001
AGE50_96	1	0.00923	0.00442	4.3593	0.0368

CUV	1	-0.8180	0.0909	81.0404	<.0001
LBS100	1	0.0115	0.00939	1.5089	0.2193
FOOTPRNT	1	-0.0397	0.0112	12.5979	0.0004
NITE	1	-0.3010	0.0555	29.4577	<.0001
RURAL	1	1.2499	0.0553	510.1798	<.0001
SPDLIM55	1	2.0612	0.0558	1366.7152	<.0001
HIFAT_ST	1	0.3931	0.0560	49.2044	<.0001
VEHAGE	1	0.0517	0.0179	8.3838	0.0038
CYGP2	1	0.1675	0.1216	1.8966	0.1685
CYGP3	1	0.0750	0.0859	0.7624	0.3826
CYGP5	1	-0.0855	0.0849	1.0159	0.3135

Odds Ratio Estimates

Effect	Point Estimate	95% Wald Confidence Limits	
ROLLCURT	0.587	0.445	0.775
ESC	0.321	0.257	0.401
FMVSS201	0.821	0.712	0.947
FEMALE	0.805	0.721	0.898
AGE14_25	1.158	1.130	1.186
AGE50_96	1.009	1.001	1.018
CUV	0.441	0.369	0.527
LBS100	1.012	0.993	1.030
FOOTPRNT	0.961	0.940	0.982
NITE	0.740	0.664	0.825
RURAL	3.490	3.131	3.890
SPDLIM55	7.855	7.042	8.762
HIFAT_ST	1.482	1.327	1.654
VEHAGE	1.053	1.017	1.091
CYGP2	1.182	0.932	1.501
CYGP3	1.078	0.911	1.276
CYGP5	0.918	0.777	1.084

Association of Predicted Probabilities and Observed Responses

Percent Concordant	86.9	Somers' D	0.739
Percent Discordant	13.0	Gamma	0.740
Percent Tied	0.1	Tau-a	0.370
Pairs	22799949	c	0.870

The section of the printout titled “Analysis of Maximum Likelihood Estimates” shows that rollover curtains **significantly reduced** fatality risk in first-event rollovers relative to the control group of non-occupant fatalities. The regression coefficient for ROLLCURT is -.5321. Its standard error is .1414. The chi-square is 14.15 (chi-square must be at least 3.84 for statistical significance at the two-sided .05 level). The next section of the printout, “Odds Ratio Estimates” indicates that rollover curtains reduce fatality risk by an estimated 41.3 percent (one minus the point estimate) with 95% confidence bounds ranging from 22.4 to 55.5 percent.

The effects of the control variables are directionally similar to the results in Section 2.1.3. It is noteworthy that the effect of ESC is especially high, corresponding to a 68-percent reduction in rollovers; the beneficial effect of FMVSS No. 201 is also higher than in the near-side impacts. The findings are consistent with earlier NHTSA evaluations.[44] The strong effects for AGE14_25, RURAL, and SPDLIM55 reflect the high propensity of rollovers (relative to pedestrian crashes) among young drivers and on rural or high-speed roads.

When the preceding regression is performed separately for CUVs and for truck-based SUVs, the fatality reductions attributed to rollover curtains are similar and they are both statistically significant: 47 percent in CUVs ($\chi^2 = 5.49$) and 39 percent in truck-based SUVs ($\chi^2 = 8.64$).

4.2 Contingency-table analyses for first-event rollovers

Similar to Section 2.2, contingency tables offer a simpler method to estimate the effect of rollover curtains, but at a cost of limiting the analyses to selected make-models that shifted to rollover curtains without simultaneously adding ESC and/or were simultaneously available with and without rollover curtains, decodable from the VIN. Appendix C of this report lists the make-models considered eligible for the analysis and the time span of model years included. Unlike Appendix B (the list used in Section 2.2), these models did not necessarily transition directly from no air bags at all to rollover curtains – there would not be enough data under that condition – but might have had other types of side air bags or non-rollover curtains before the transition; Appendix C describes what other bags were standard or optional. These other air bags are unimportant in analyses of first-event rollovers, because they are not designed to deploy in rollovers. Make-models had to meet the following criteria to be included:

- They included some vehicles with standard or VIN-identifiable rollover curtains and others without rollover curtains.[45]
- Models are included for a range of at most six MY.
- Within the included range of MY, the annual percentages of vehicles equipped with ESC may not vary by more than 10 percentage points.
- The range of MY included may be truncated or adjusted, if necessary, to “balance” the database to contain, in each make-model, approximately twice as many cases without rollover curtains as cases with rollover curtains. Balancing the database is important to avoid, for example, that most of the vehicles without rollover curtains are CUVs and most of those with the curtains are truck-based SUVs; if that were the case, the statistics might reflect the difference between CUVs and SUVs rather than the effect of the rollover curtains. For some make-models where rollover curtains are VIN-identifiable but

[44] Sivinski (2011); Kahane (2011).

[45] Appendix C identifies a few make-models and MY in which small proportions (4 to 20%) of vehicles were equipped optional, non-identifiable rollover curtains; these are included in the group without rollover curtains.

fairly uncommon options, “balancing” is accomplished by randomly excluding half the cases without the rollover curtains.[46]

For the selected make-models and model years, the database contains the same types of fatality cases as the regression analysis: driver and RF passenger fatalities in first-event rollovers, and the non-occupant fatalities struck by these vehicles. Table 17 is a 2x2 table of rollover versus non-occupant fatalities, with and without rollover curtains. Table 17 includes only 82 rollover fatality cases with rollover curtains, less than the 130 in the regression analysis; some cases could not be used here because the make-model received ESC at or near the same time as the curtains, or because it was always produced with rollover curtains. On the other hand, by limiting to specific make-models produced both with and without the curtains and by balancing the samples, it was possible to include some cars (e.g., Ford Taurus, Cadillac CTS, and Mercedes), pickup trucks (Nissan Frontier and Toyota Tacoma) and minivans (Ford Freestyle) that were excluded in the regression.

Table 17: Contingency-Table Analysis of Fatality Reduction by Rollover Curtains in First-Event Rollovers

Frequency Row Pct	NON-OCCUPANT	FIRST EVENT ROLLOVER	Total
NO ROLLOVER CURTAIN	457 57.99	331 42.01	788
ROLLOVER CURTAIN	211 72.01	82 27.99	293
Total	668	413	1081

Statistic	DF	Value	Prob
Chi-Square	1	17.7791	<.0001
Likelihood Ratio Chi-Square	1	18.2998	<.0001
Continuity Adj. Chi-Square	1	17.1903	<.0001
Mantel-Haenszel Chi-Square	1	17.7627	<.0001

Estimates of the Relative Risk (Row1/Row2)

Type of Study	Value	95% Confidence Limits	
Odds Ratio	0.5366	0.4008	0.7183

[46] By deleting cases with ST_CASE ending in 0, 2, 4, 6, or 8 if ROLLCURT = 0; these make-models are Dodge Durango, Ford Explorer, Mercury Mountaineer, Ford Freestar, and Mercury Monterey.

Table 17 has enough data to show a clear reduction of rollover fatalities with rollover curtains, relative to non-occupant cases. Chi-square ranges from 17.19 to 18.30, well above the 3.84 needed for statistical significance. The initial estimate of fatality reduction – i.e., one minus the "Odds Ratio" in Table 17 – is 46.3 percent.

A minor flaw in this initial analysis is that it is difficult to "balance" the database exactly. In the less rollover-prone types of vehicles – cars, CUVs, and minivans – 36 percent of the vehicles were equipped with rollover curtains. For the more rollover-prone types – pickup trucks and truck-based SUVs – only 29 percent were so equipped. These percentages are close, but there remains a slight bias in favor of rollover curtains, because relatively more of the equipped vehicles are cars, CUVs or minivans. The bias can be controlled by transforming the analysis to a logistic regression with the dependent variable ROLL1, the primary independent variable ROLLCURT, and just one control variable, CUV. The regression generates a coefficient of -.5950 for ROLLCURT, which is statistically significant (χ^2 = 15.08) and corresponds to a fatality reduction of 44.8 percent, just slightly lower than the 46.3 percent from the contingency-table analysis, but slightly higher than the 41.3 percent from regression in Section 4.1.

When the contingency-table analysis of Table 17 is performed separately for two subgroups of vehicles in the database, the fatality reductions attributed to rollover curtains are similar and they are both statistically significant: 53 percent in cars, CUVs, and minivans (χ^2 = 6.93) and 38 percent in pickup trucks and truck-based SUVs (χ^2 = 7.01). This, too, is consistent with the regression in Section 4.1.

4.3 Analyses of fatal ejections in first-event rollovers

The effectiveness of rollover curtains in preventing fatal ejections in first-event rollovers is a matter of special interest, because rollover curtains are likely to be a prime technology for meeting FMVSS No. 226, "Ejection mitigation."[47] Without rollover curtains, approximately 63 percent of the driver and RF passenger fatalities in first-event rollovers were ejected from the vehicle. The effect of rollover curtains on fatal ejections may be estimated by repeating the regressions and contingency-table analyses of Sections 4.1 and 4.2, but limiting the occupant fatalities to people who were completely or partially ejected (EJECTION = 1, 2, or 9). One additional modification in the regression of Section 4.1 is to omit the FMVSS201 control variable, because, intuitively, the energy-absorbing materials initially used to meet the head-impact upgrade of FMVSS No. 201 would neither prevent ejection nor protect an ejected occupant.

The regression analysis for ejection fatalities in first-event rollovers of CUVs and truck-based SUVs, corresponding to the analysis in Section 4.1, generates a coefficient of -.6067 for ROLLCURT, which is statistically significant (χ^2 = 12.01); based on the odds-ratio, the estimated reduction of fatal ejections is 45.5 percent, with confidence bounds from 23.2 to 61.3 percent. It is quite similar to the 41.3 percent overall fatality reduction in first-event rollovers estimated in Section 4.1.

[47] *Federal Register* 76 (January 19, 2011): 3212.

Table 18: Reduction of Fatal Ejections by Rollover Curtains in First-Event Rollovers

Frequency Row Pct	NON-OCCUPANT	FATAL EJECTION FIRST EVENT ROLLOVER	Total
NO ROLLOVER CURTAIN	457 72.20	176 27.80	633
ROLLOVER CURTAIN	211 82.10	46 17.90	257
Total	668	222	890

Statistic	DF	Value	Prob
Chi-Square	1	9.5792	0.0020
Likelihood Ratio Chi-Square	1	10.0259	0.0015
Continuity Adj. Chi-Square	1	9.0575	0.0026
Mantel-Haenszel Chi-Square	1	9.5685	0.0020

Estimates of the Relative Risk (Row1/Row2)

Type of Study	Value	95% Confidence Limits	
Odds Ratio	0.5661	0.3937	0.8140

When the contingency-table analysis of the make-models in Appendix C is similarly limited to ejection fatalities, Table 18 shows a statistically significant 43.4-percent fatality reduction with rollover curtains, relative to non-occupant cases. Chi-square ranges from 9.06 to 10.03. If the analysis of these make-models is transformed to a logistic regression with the single control variable CUV, the regression coefficient for ROLLCURT is -.5421, which is statistically significant (χ^2 = 8.19) and corresponds to a 41.8-percent reduction of fatal ejections. Again, this is similar to the 45.5-percent overall fatality reduction in first-event rollovers estimated by the corresponding analysis in Section 4.2.

4.4 Analyses of subsequent-event rollovers that are not side impacts

The two previous sections are strong evidence, even with the limited available data, that rollover curtains are effective in first-event rollovers and that they often prevent ejections. To the extent that some of the fatalities in subsequent-event rollovers are also ejections through the side windows, for example, rollover curtains might be effective there, too, assuming they deploy. The issue may be addressed, as above, with logistic regressions and contingency tables. However, the analyses in this section are limited, for two reasons, to subsequent-event rollovers that are not side impacts: (1) Sections 4.5 and 4.6 will separately address rollovers subsequent to near-side and far-side impacts; (2) A crucial assumption in the preceding analyses is that other types of side air bags including non-rollover curtains would have little or no effect (and likely not even deploy) – this assumption might not be valid if the initial impact is lateral, especially if it is a near-side impact.

The occupant fatalities in this section are occupants of vehicles where FARS judged a rollover to be the most harmful event (M_HARM = 1), including involvements in single- and multi-vehicle crashes. First-event rollovers, as defined in Section 4.1, are excluded (i.e., single-vehicle crashes where the rollover itself was the first harmful event or a tripping mechanism was the first event). Also excluded are near-side impacts as defined in Section 2.1.2 and far-side impacts as defined in Section 3.1 (i.e., if the initial and/or the principal impact was a side impact); however, if the vehicle was impacted on both sides or if the first event was a non-collision (HARM_EV = 2 to 6), this crash is not counted as either "near-side" or "far-side" and would be included here if M_HARM = 1. Thus, the rollovers included here primarily happened after frontal impacts or, less frequently, after rear impacts or some type of non-collision event that FARS does not classify as an impact to a specific location on the front, side, or rear of the vehicle. One issue discussed in the preamble of the FMVSS No. 226, "Ejection mitigation" final rule is whether a severe frontal impact might result in a vehicle losing all electric power before the post-impact rollover and, as a result, prevent deployment of the rollover curtain.[48] The database has 141 fatality cases in such rollovers of CUVs and truck-based SUVs equipped with rollover curtains: slightly more cases than in first-event rollovers (130).

The regression analysis of Section 4.1 is repeated with these subsequent-event rollovers replacing the first-event rollovers, but with the same non-occupant cases as before. The regression generates a coefficient of -.0309 for ROLLCURT, which is not statistically significant (χ^2 = .05); it corresponds to a negligible fatality reduction of 3.0 percent, with confidence bounds from -27.1 to +26.0 percent.

Table 19, a contingency-table analysis of the make-models in Appendix C, likewise shows a negligible, non-significant 4.2 percent fatality reduction with rollover curtains, relative to non-occupant cases. Chi-square ranges from .03 to .07.

If the analysis of these make-models is transformed to a logistic regression with the single control variable CUV, the regression coefficient for ROLLCURT is +.0164, which is not statistically significant (χ^2 = .01) and corresponds to a 1.7-percent fatality increase.

With the data available so far, none of the analyses suggest a benefit for rollover curtains in subsequent-event rollovers that are not side impacts.

[48] *Federal Register* 76 (January 19, 2011): 3212.

Table 19: Fatalities in Subsequent-Event Rollovers That Are Not Side Impacts

Frequency Row Pct	NON-OCCUPANT	MOST-HARMFUL SUBSEQ-EVENT ROLLOVER	Total
NO ROLLOVER CURTAIN	457 74.55	156 25.45	613
ROLLOVER CURTAIN	211 75.36	69 24.64	280
Total	668	225	893

Statistic	DF	Value	Prob
Chi-Square	1	0.0662	0.7969
Likelihood Ratio Chi-Square	1	0.0664	0.7967
Continuity Adj. Chi-Square	1	0.0304	0.8617
Mantel-Haenszel Chi-Square	1	0.0661	0.7970

Estimates of the Relative Risk (Row1/Row2)

Type of Study	Value	95% Confidence Limits	
Odds Ratio	0.9580	0.6908	1.3285

4.5 Analyses of rollover curtains in near-side impacts

Are rollover curtains (with or without torso bags) more effective in near-side impacts than non-rollover curtains (with the same status for the torso bags)? The issue here is not the rollover sensor, because the near-side impact has presumably already deployed the curtains. The issue is whether the other features that tend to be characteristic of rollover curtains, such as covering a larger area and/or staying inflated for a longer time might save some occupants. Specifically, these features might help the 6 percent of the fatally injured occupants in near-side impacts who are in crashes with a subsequent rollover that FARS deems the most harmful event or the 15 percent of the fatally injured occupants in near-side impacts who are completely or partially ejected. Furthermore, many real-world near-side impacts are not centered on the occupant compartment (as in the FMVSS No. 214 test with the MDB) but may be located some distance to the front or behind the occupant, resulting in more complex trajectories where a larger, longer-inflated curtain might help.

The regression analysis used for first-event rollovers in Section 4.1 is not appropriate here, because it assumed that side air bags other than rollover curtains had no effect – but in these near-side impacts, Chapter 2 has already shown that all types of side air bags are beneficial. Instead, the approach is to repeat the principal regression analysis of Section 2.1.3 (which already has independent variables CURT_TORS, CURTAIN, COMBO, and TORSO) and to add one more variable, ROLLCURT. This will estimate the average of the incremental effectiveness of rollover curtain-plus-torso relative to non-rollover curtain-plus-torso and the incremental effectiveness of rollover curtain-only relative to non-rollover curtain only – i.e., the average potentiating effect, if any, of changing the typical non-rollover curtain to the typical rollover curtain. Furthermore, it is appropriate, as in the preceding sections of this chapter, to limit the regression to CUVs and truck-based SUVs, because they are the only types of vehicles where there are appreciable numbers of rollover curtains in the currently available FARS data.

The regression generates a coefficient of -.2580 for ROLLCURT, which corresponds to a 22.7-percent fatality reduction relative to comparable systems with non-rollover curtains. The effect is not statistically significant at the .05 level: chi-square is 2.90, which falls short of the 3.84 needed for significance at the .05 level, but does exceed the 2.71 needed for a borderline significance at the one-sided .05 level.

The contingency-table analysis in Section 4.2 is likewise not directly applicable, because the vehicles without rollover curtains include a mix of other types of air bags. However, quite a few of the make-models listed in Appendix C shifted directly from non-rollover curtains plus torso bags to rollover curtains plus torso bags.[49] Restricting the analysis to these models yields a "clean" comparison of the effect of changing from non-rollover to rollover curtains, each with torso bags – although it is a comparison based on limited data (approximately ¼ of the vehicles covered by Appendix C, which is already a limited group of makes and models).

Table 20 estimates a 44.2-percent fatality reduction in near-side impacts for these makes and models when they became equipped with rollover curtains – a remarkable effect at first glance, but the statistical significance is borderline: chi-square just exceeds 3.84 by three of the four formulas, but the continuity-adjusted chi-square falls short. Table 20 includes just 23 cases of near-side fatalities with rollover curtains (as compared, for example, to 82 in the corresponding cell of Table 17). It is little more than a "first look."

[49] Dodge Journey; Ford Flex; Cadillac CTS and SRX; Volkswagen Touareg, Porsche Cayenne, BMW X5, Nissan Murano, Mercedes S, CL, CLK, and E-series; Subaru Outback; Toyota FJ Cruiser; Volvo S60 and XC60; Suzuki Grand Vitara; Hyundai Tucson; Infiniti FX; and Lexus GX and RX330.

Table 20: Fatality Reduction by Rollover Curtains in Near-Side Impacts
(Make-models that shifted from non-rollover curtains plus torso bags
to rollover curtains plus torso bags without changing ESC status)

Frequency Row Pct	NON-OCCUPANT	NEARSIDE IMPACT	Total
NONROLLOVER CURTAIN + TORSO	92 62.59	55 37.41	147
ROLLOVER CURTAIN + TORSO	69 75.00	23 25.00	92
Total	161	78	239

Statistic	DF	Value	Prob
Chi-Square	1	3.9671	0.0464
Likelihood Ratio Chi-Square	1	4.0497	0.0442
Continuity Adj. Chi-Square	1	3.4225	0.0643
Mantel-Haenszel Chi-Square	1	3.9505	0.0469

Estimates of the Relative Risk (Row1/Row2)

Type of Study	Value	95% Confidence Limits	
Odds Ratio	0.5576	0.3128	0.9940

4.6 Analyses of rollover curtains in far-side impacts

The situation in far-side impacts is not unlike near-side impacts. Again, the issue is not the rollover sensor, because the side impact should already have deployed the curtains. The issue is other features of the air bags, such as the area they cover and the length of time they stay inflated. In far-side impacts, 11 percent of the fatalities are in crashes with a subsequent rollover that FARS deems the most harmful event and 21 percent of the fatalities are completely or partially ejected – higher proportions than in near-side impacts – and occupant trajectories may be complex, with a variety of possible injury sources. These circumstances might make a large and long-lasting curtain advantageous.

Unlike the results in Chapter 2 for near-side impacts, the analyses in Chapter 3 did not lead to a conclusion on whether the various types of side air bags are beneficial in far-side impacts. Thus, there is no obvious preference between the regression method used for rollovers in Sections 4.1, 4.2, and 4.3 (which assumed other air bags and non-rollover curtains had no effect) and the method for near-side impacts in Section 4.4 (which included independent variables for the various other types of air bags). It seems appropriate to try both regressions, applying them to the data for CUVs and truck-based SUVs.

The regression model that was used for the rollover analyses, when applied to far-side impacts, generates a coefficient of -.3151 for ROLLCURT, which corresponds to a 27.0-percent fatality reduction for rollover curtains. The effect is not statistically significant; chi-square is 3.82, which falls short of the 3.84 needed for significance at the .05 level, but does exceed the 2.71 needed for a borderline significance at the one-sided .05 level. The other regression (which includes the variables CURT_TORS, CURTAIN, COMBO, and TORSO) generates a somewhat higher -.4342 coefficient for ROLLCURT, corresponding to a 35.2-percent fatality reduction. It does reach statistical significance, with a chi-square of 4.84.

There are similar choices on how to perform the contingency-table analysis, but here the obvious preference is to use all the make-models in Appendix C, because there is 4 times the data. Table 21 shows a 30.2-percent fatality reduction in far-side impacts when these make-models were equipped with rollover curtains. The effect is not statistically significant, with chi-square by the various computation methods ranging from 2.80 to 3.23, but these values do exceed the 2.71 needed for a borderline significance at the one-sided .05 level.

Table 21: Fatality Reduction by Rollover Curtains in Far-side Impacts
(Make-models that shifted to rollover curtains plus torso bags without changing ESC status)

Frequency Row Pct	NON-OCCUPANT	FARSIDE IMPACT	Total
NO ROLLOVER CURTAIN	457 79.48	118 20.52	575
ROLLOVER CURTAIN	211 84.74	38 15.26	249
Total	668	156	824

Statistic	DF	Value	Prob
Chi-Square	1	3.1331	0.0767
Likelihood Ratio Chi-Square	1	3.2347	0.0721
Continuity Adj. Chi-Square	1	2.7997	0.0943
Mantel-Haenszel Chi-Square	1	3.1293	0.0769

Estimates of the Relative Risk (Row1/Row2)

Type of Study	Value	95% Confidence Limits	
Odds Ratio	0.6975	0.4674	1.0409

4.7 Preliminary conclusions: rollover curtains

Two statistical analyses of first-event rollovers generated strong, statistically significant (χ^2 = 14.15 and 15.08, respectively), and consistent findings that rollover curtains reduce fatality risk. The observed effect is 41.3 percent in the regression analysis of Section 4.1 and 44.8 percent in the contingency-table analysis of Section 4.2, after controlling for vehicle type. While the findings are still based on relatively little data and the analyses should probably be repeated in about 3 or 4 years, they are sufficient to conclude that rollover curtains are effective in first-event rollovers. The regression in Section 4.1 is the better estimate, because it is based on more data: it is a 41.3-percent reduction, with confidence bounds ranging from 22.5 to 55.5 percent. NHTSA will use this estimate in its upcoming analysis of lives saved by FMVSS and vehicle safety technologies through 2011.

The two analyses of fatal ejections in first-event rollovers in Section 4.3 produced statistically significant estimates of 45.5 and 41.8-percent fatality reduction, respectively. These are almost the same as the estimates of overall fatality reduction in those crashes. The preliminary conclusion is that rollover curtains are about equally effective in reducing ejection and non-ejection fatalities in first-event rollovers.

Section 4.4 analyzed most-harmful-event rollovers that are not first-event rollovers and also not side impacts followed by a rollover. The observed effects of rollover curtains are negligible. It may be a good idea to repeat the analyses when there is more data, but for the time being, NHTSA will not attribute any life-savings to rollover curtains here.

The analyses of near-side and far-side impacts in Sections 4.5 and 4.6 do not lead to obvious conclusions. They generally showed positive results for rollover curtains, but with limited numbers of cases and with some chi-squares just above and others just below the level needed for statistical significance. The three analyses of far-side impacts are basically three somewhat different techniques applied to more or less the same data; thus, the three borderline results do not add up to something stronger, but remain inconclusive – likewise for the two analyses of near-side impacts. For the time being it seems prudent not to attribute an incremental benefit to rollover curtains in near-side or far-side impacts, although that conclusion may change with additional data. When these results are combined with the findings of Chapters 2 and 3, the estimates in Chapter 2 of fatality reduction in near-side impacts by curtain-plus-torso bags and by curtains alone can for now apply to both rollover curtains and non-rollover curtains. In far-side impacts, NHTSA will for the time being not attribute fatality reductions to any type of curtain or side air bags, but the agency may study the subject once again when more data become available.

Appendix A

Curtain and Side Air Bags, by Type, MY 1996-2011

There were no side air bags of any type before 1996. The numeric codes shown before the make-model names plus any "CG" codes are the ones assigned by the VIN-decode programs developed by NHTSA's Evaluation Division; for passenger cars, they are usually the same as the make-model codes in FARS. These programs are updated periodically and are available to the public. The second column is the model year. The third column shows the availability and types of air bags: "S" = standard equipment; "N" = not available; "if V3=8" means standard equipment on the sub-series when the third VIN character is "8" and not available on other sub-series. A number such as "torso 3" means that torso bags were optional and were on 3 percent of the vehicles, but these vehicles cannot be individually identified from their VINs.

Sources: www.safercars.gov and www.cars.com, supplemented by VIN-decode information from the National Insurance Crime Bureau's *Passenger Vehicle Identification Manuals* and percentages from Ward's *Automotive Yearbooks* when the bags are optional and not VIN-decodable. Blue print indicates that the percentage has been inferred from adjacent model years or similar vehicles when Ward's has no percentage for that MY or the author believes this generates a more accurate estimate.

2001 Jeep Compass	2007	rollover curtain S torso 3
	2008	rollover curtain S torso 8
	2009	rollover curtain S torso 12
	2010	rollover curtain S torso 6
	2011	rollover curtain S torso 12
2300-2303 Jeep Cherokee	1996-2001	N
2312-2313 Jeep Grand Cherokee	thru 2001	N
	2002-2005	curtain if V3=8
	2006	rollover curtain if V3=8
	2007-2010	rollover curtain S
	2011	rollover curtain plus torso S
2316-2317 Jeep Commander	2006-2010	rollover curtain S
2320-2323 Jeep Wrangler	thru 2006	N
	2007-2009	combo if V3=8
	2010-2011	combo if V4=G,H
2342-2343 Jeep Liberty	2002-2007	curtain if V3=8
	2008-2011	rollover curtain S
2352-2353 Jeep Patriot	2007	rollover curtain S torso 3
	2008	rollover curtain S torso 9
	2009	rollover curtain S torso 14
	2010	rollover curtain S torso 12
	2011	rollover curtain S torso 9

3301-3303 Hummer H1	1996-2006	N
3307 Hummer H3	2006	rollover curtain 27
	2007	rollover curtain 30
	2008-2010	rollover curtain S
3313-3317 Hummer H2	2003-2007	N
	2008-2009	rollover curtain S
6018 Chrysler 200 CV	2011	combo S
6018 Chrysler 200 Sedan	2011	curtain plus torso S
6041 Chrysler Concorde	thru 2000	N
	2001-2004	combo if V4=A
6042 Chrysler LHS	thru 2000	N
	2001	combo if V4=A
6043 Chrysler Sebring CV	thru 2006	N
	2007	[no Sebring CV]
	2008-2010	combo S
6043 Chrysler Sebring Coupe	thru 2003	N
	2004	combo 2
	2005	combo 1
6043 Chrysler Sebring Sedan	2001-2005	curtain if V4=A
	2006	curtain if V4=A,H,L
	2007-2010	curtain plus torso S
6044 Chrysler Cirrus	thru 2000	N
	2001	curtain if V4=A
6051 Chrysler 300	thru 2000	N
	2001-2004	combo if V4=A
	2005-2007	curtain if V4=A,H,L
	2008-2009	curtain plus torso if V4=A,H,L
	2010-2011	curtain plus torso S
6052 Chrysler PT Cruiser CV	2005-2007	combo if V4=A,H
	2008-2009	combo S
6052 Chrysler PT Cruiser SUV	2001-2007	combo if V3=8,A
	2008-2010	combo S
6053 Chrysler Prowler	2001-2002	N
6054 Chrysler Pacifica	2004-2006	curtain if V3=8
	2007-2008	curtain S
6055 Chrysler Crossfire	2004-2008	torso S
6312-6317 Chrysler Aspen	2007-2009	rollover curtain S
6402 Chrysler Voyager	thru 2000	N
	2001-2003	combo if V3=8
6402-6408 Chrysler Town & C	thru 2000	N
	2001-2004	combo if V3=8
	2005-2007	curtain if V3=8
	2008-2010	rollover curtain S
	2011	rollover curtain plus torso S
6409 Chrysler Grand Voyager	thru 2000	N

7013 Dodge Viper	1996-2010	N
7020 Dodge Neon	thru 2000	N
	2001-2005	combo if V4=A
7021 Dodge Magnum	2005-2007	curtain if V3=8
	2008	curtain plus torso if V3=8
7024 Dodge Charger	2006-2007	curtain if V4=L
	2008-2009	curtain plus torso if V4=L
	2010-2011	curtain plus torso S
7025 Dodge Caliber	2007	curtain S torso 1
	2008-2010	curtain S torso 3
	2011	curtain S torso 4
7026 Dodge Avenger	2008-2011	curtain plus torso S
7027 Dodge Journey CUV	2009	curtain plus torso S
	2010-2011	rollover curtain plus torso S
7028 Dodge Challenger	2008-2010	curtain S
	2011	curtain plus torso S
7039 Dodge Stealth	1996	N
7041 Dodge Intrepid	thru 2000	N
	2001-2004	combo if V4=A
7042 Dodge Avenger	1995-2000	N
7043 Dodge Stratus Coupe	2001-2003	N
	2004	combo 2
	2005	combo 1
7043 Dodge Stratus Sedan	thru 2000	N
	2001-2005	curtain if V4=A
	2006	curtain if V4=A,H,L
7200-7209 Dodge Dakota	thru 2004	N
	2005-2009	curtain if V3=3
	2010	curtain if V4=R,S
	2011	curtain S
7210-7219 Dodge Ram Pk 1500	thru 2001	N
	2002-2008	curtain if V3=3
	2009-2011	curtain S
7220-7229 Dodge Ram Pk 2500	thru 2002	N
	2003-2009	curtain if V3=3
	2010-2011	curtain S
7312-7313 Dodge Durango	thru 2001	N
	2002-2003	curtain if V3=8
	2004-2006	rollover curtain if V3=8
	2007-2009	rollover curtain S
	2010	[no Durango]
	2011	rollover curtain plus torso S
7342-7343 Dodge Nitro	2007-2011	rollover curtain S

7400-7409 Dodge Caravan	thru 2000	N
	2001-2004	combo if V3=8
	2005-2007	curtain if V3=8
	2008-2010	rollover curtain S
	2011	rollover curtain plus torso S
7410 Dodge Ram Van	1996-2003	N
9020 Plymouth Neon	thru 2000	N
	2001	combo if V4=A
9038 Plymouth Breeze	1996-2000	N
9039 Plymouth Prowler	1997-2000	N
9402-9407 Plymouth Voyager	1996-2000	N
10… Eagle		N
11420-11429 Sprinter 2500	2002-2006	N
	2007-2009	0 (curtain plus torso optional, but probably few)
	2010-2011	curtain plus torso if V8=D
11430-11439 Sprinter 3500	2002-2006	N
	2007-2009	0 (curtain plus torso optional, but probably few)
	2010-2011	curtain plus torso if V8=D
12003 Ford Mustang	thru 2004	N
	2005-2007	combo if V4=H
	2008-2011	combo S
12004 Ford Thunderbird	thru 1997	N
	1998-2001	[no Thunderbird]
	2002-2005	combo S
12013 Ford Escort	1996-2003	N
12016 Ford Crown Victoria	thru 2002	N
	2003-2008	combo if V4=H
	2009-2011	combo S
12017 Ford Taurus	thru 1999	N
	2000-2007	combo if V4=H
	2008-2011	rollover curtain plus torso S
12018 Ford Probe	1996-1997	N
12021 Ford 500	2005-2007	rollover curtain plus torso if V4=H
12022 Ford Freestyle	2005-2007	rollover curtain plus torso if V4=D
12023 Ford Fusion	2006	curtain plus torso if V4=H
	2007-2011	curtain plus torso S
12024 Ford Edge	2007-2011	rollover curtain plus torso S
12025 Ford Flex CUV	2009	curtain plus torso S
	2010-2011	rollover curtain plus torso S
12032 Ford Fiesta	2011	curtain plus torso S
12035 Ford Contour	1995-2000	N
12036 Ford Aspire	1996-1997	N

12037 Ford Focus	2000-2007	combo if V4=H
	2008-2011	curtain plus torso S
12038 Ford GT	2004-2006	N
12200-12205 Ford Ranger	thru 2009	N
	2010-2011	combo S
12210-12219 Ford F-150 Pk	thru 2008	N
	2009-2011	rollover curtain plus torso S
12220-12239 Ford Super-Duty Pk	thru 2010	N
	2011	rollover curtain plus torso S
12300,01,02,03,08 Ford Explorer	thru 1998	N
	1999-2001	combo if V4=C,D,E
	2002-2005	rollover curtain if V4=C,D,E
	2006	torso S, rollover curtain 45
	2007	torso S, rollover curtain 57
	2008-2011	rollover curtain plus torso S
12306,07 Ford Explorer Sport-Trac	2001-2002	N
	2003-2005	rollover curtain if V4=C,D,E
	2006	torso S, rollover curtain 45
	2007	torso S, rollover curtain 57
	2008-2010	rollover curtain plus torso S
12312-12317 Ford Expedition	thru 1999	N
	2000-2002	combo if V4=E,F
	2003-2006	rollover curtain if V4=E,F
	2007-2011	rollover curtain plus torso S
12325 Ford Bronco	1996	N
12332-12333 Ford Excursion	2000-2005	N
12342-12347 Ford Escape	2001-2004	combo if V4=C
	2005	rollover curtain if V4=C
	2006-2007	rollover curtain plus torso if V4=C
	2008-2011	rollover curtain plus torso S
12402 Ford Wind/Freestar	thru 1998	N
	1999-2003	combo if V4=D
	2004-2007	rollover curtain plus torso if V4=D
12410-12439 Ford E Van	1996-2011	N
12440-12449 Ford Aerostar	1996-1997	N
12460-12462 Ford Transit Connect	2010-2011	combo S
13001 Lincoln Town Car	thru 1998	N
	1999-2011	combo S
13002 Lincoln Mark8	1996-1998	N
13005 Lincoln Continental	thru 1998	N
	1999-2002	combo S
13012 Lincoln LS	2001-2003	combo S
	2004	combo S curtain 20
	2005	combo S curtain 20
	2006	combo S curtain 21

13013 Lincoln MKZ	2007-2011	curtain plus torso S
13014 Lincoln MKX	2007-2011	rollover curtain plus torso S
13015 Lincoln MKS	2009-2011	rollover curtain plus torso S
13016 Lincoln MKT	2010-2011	rollover curtain plus torso S
13214-13215 Lincoln pickup	2002-2008	N
13302 Lincoln Aviator	2003-2005	rollover curtain S
13312 Lincoln Navigator	thru 1999	N
	2000-2002	combo S
	2003-2006	rollover curtain S
	2007-2011	rollover curtain plus torso S
14004 Mercury Cougar	1996-1997	N
14016 Mercury Grand Marquis	thru 2002	N
	2003-2008	combo if V4=H
	2009-2011	combo S
14017 Mercury Sable	thru 1999	N
	2000-2005	combo if V4=H
	2006-2007	[no Sable]
	2008-2009	rollover curtain plus torso S
14020 Mercury Montego	2005-2007	rollover curtain plus torso if V4=H
14021 Mercury Milan	2006	curtain plus torso if V4=H
	2007-2010	curtain plus torso S
14036 Mercury Tracer	1996-1999	N
14037 Mercury Mystique	1995-2000	N
14038 Mercury Cougar	1999-2002	combo if V4=H
14039 Mercury Marauder	2003-2004	combo if V4=H
14302-08 Mercury Mountaineer	thru 1998	N
	1999-2001	combo if V4=D,E
	2002-2005	rollover curtain if V4=D,E
	2006	torso S, rollover curtain 50
	2007	torso S, rollover curtain 100
	2008-2010	rollover curtain plus torso S
14342-14347 Mercury Mariner	2005-2007	rollover curtain plus torso if V4=C
	2008-2011	rollover curtain plus torso S
14402 Mercury Monterey	2004-2006	rollover curtain plus torso if V4=D
	2007	rollover curtain plus torso S
14450-14452 Mercury Villager	1996-2002	N
18002 Buick LeSabre	thru 1999	N
	2000-2002	torso S
	2003-2005	torso if V7=4
18003 Buick Park Avenue	thru 1999	N
	2000-2005	torso S
18004 Buick Roadmaster	1996	N
18005 Buick Riviera	1996-1999	N
18017 Buick Century	thru 1999	N
	2000-2005	combo for driver only if V7=5

18018 Buick Skylark	1996-1998	N
18019 Buick Regal	2011	rollover curtain plus torso S
18020 Buick Regal	thru 1999	N
	2000-2004	combo for driver only if V7=5
18022 Buick LaCrosse	2005	curtain if V7=6
	2006-2009	curtain S (Ward’s 100%, cars.com)
	2010-2011	rollover curtain plus torso S
18023 Buick Lucerne	2006-2011	curtain plus torso S
18024 Buick Enclave CUV	2008-2011	rollover curtain plus torso S
18302-18303 Buick Rainier	2004	torso 42
	2005	rollover curtain 19, torso 19
	2006	rollover curtain 27
	2007	rollover curtain 28
18356-18357 Buick Rendezvous	2002	combo S for driver, torso S for RF
	2003	combo 61 for driver, torso 61 for RF
	2004	combo 73 for driver, torso 73 for RF
	2005	combo 66 for driver, torso 66 for RF
	2006	combo 61
	2007	combo 60
18454-18547 Buick Teraza	2005	combo 80
	2006	combo 89
	2007	combo 90
19003 Cadillac DeVille	1996	N
	1997-2005	torso S
19005 Cadillac Eldorado	1996-2002	N
19014 Cadillac Seville	1996-1997	N
	1998-2000	torso S
	2001-2004	combo S for driver, torso S for RF
19017 Cadillac Catera	1997-1999	torso if V7=4
	2000-2001	torso S
19018 Cadillac CTS	2003-2009	curtain plus torso S
	2010-2011	rollover curtain plus torso S
19019 Cadillac XLR	2004-2011	combo S
19020 Cadillac SRX	2004-2005	curtain plus torso S
	2006-2011	rollover curtain plus torso S
19021 Cadillac STS	2005-2011	curtain plus torso S
19022 Cadillac DTS	2006-2011	curtain plus torso S
19312-19343 Cadillac Escalade	1999-2000	N
	2001	[no Escalade]
	2002-2006	torso S
	2007-2009	rollover curtain S
	2010-2011	rollover curtain plus torso S

20002 Chevrolet Impala	1996	N
	1997-1999	[no Impala or Caprice]
	2000-2005	combo for driver only if V7=5
	2006-2008	curtain if V7=8
	2009-2011	curtain plus torso S
20004 Chevrolet Corvette	thru 2004	N
	2005	combo if V7=4
	2006-2009	combo if V7=6
	2010-2011	combo S
20009 Chevrolet Camaro	thru 2002	N
	2003-2009	[no Camaro]
	2010-2011	combo S on CV, rollover curtain plus torso S on others
20016 Chevrolet Cavalier	thru 2002	N
	2003-2005	torso if V7=4
20019 Chevrolet Beretta/Corsica	1996	N
20020 Chevrolet Lumina	1996-2001	N
20022 Chevrolet Cobalt	2005	curtain if V7=4
	2006-2007	curtain if V7=8
	2008-2010	curtain S (cars.com, Ward's 100%)
20023 Chevrolet HHR	2006	curtain 19
	2007	curtain 26
	2008	curtain 17
	2009-2011	rollover curtain S (cars.com, Ward's 100%)
20024 Chevrolet Traverse CUV	2009-2011	rollover curtain plus torso S
20025 Chevrolet Cruze	2011	rollover curtain plus torso S
20026 Chevrolet Volt	2011	rollover curtain plus torso S
20027 Chevrolet Caprice Police	2011	curtain plus torso S
20032 Chevrolet Prizm	thru 1997	N
	1998-2002	torso if V7=4
20034 Chevrolet Metro	1996-2001	N
20036 Chevrolet Monte Carlo	thru 2000	N
	2001-2005	combo for driver only if V7=5
	2006-2007	combo if V7=6
20037 Malibu/Classic CG 18068	1997-2005	N . .
20037 Malibu CG 18078	2004	curtain if V7=4
	2005	curtain if V7=4 (a very few may also have torso)
	2006	curtain plus torso if V7=3
	2007-2008	curtain S, also torso if V7=7
20037 Malibu/Maxx CG 18079	2004	curtain if V7=4
	2005	curtain if V7=4 (a very few may also have torso)
	2006	curtain plus torso if V7=3
	2007	curtain S, also torso if V7=7
	2008-2011	curtain plus torso S
20038 Chevrolet SSR	2003	combo S
	2004-2006	torso S

20039 Chevrolet Aveo	2004-2005	N
	2006-2007	combo if V7=6
	2008-2011	combo S
20200-05 Chevrolet S/Colorado	thru 2003	N
	2004-2005	curtain 27
	2006	curtain 7
	2007	curtain 21
	2008-2009	curtain 11
	2010-2011	curtain S
20210-15 Chev Silverado 1500	thru 2006	N
	2007	rollover curtain 10
	2008	rollover curtain 11
	2009	rollover curtain 8
	2010-2011	rollover curtain plus torso S
20220-25 Chev Silverado 2500	thru 2010	N
	2011	torso if V7=D; curtain if V7=F,H; C+T if V7=E
20230-35 Chev Silverado 3500	1996-2011	N
20300-20303 Chevrolet Blazer	1996-2005	N
20302-07 Chevrolet Trailblazer	2002	torso S
	2003	torso 35
	2004	torso 13
	2005	rollover curtain 7
	2006	rollover curtain 19
	2007	rollover curtain 20
	2008-2009	rollover curtain S
20310-20313 Chevrolet Tahoe	thru 1999	N
	2000-2002	torso S
	2003	torso 34
	2004	torso 42
	2005-2006	torso 44
	2007-2009	rollover curtain S
	2010-2011	rollover curtain+torso S
		(V6=D [hybrid] is rollover curtain only)
20322-20327 Chevrolet Suburban	thru 1999	N
	2000-2002	torso S
	2003	torso 38
	2004	torso 49
	2005	torso 35
	2006	torso 72
	2007	rollover curtain 65
	2008-2009	rollover curtain S
	2010-2011	rollover curtain plus torso S
20330-20333 Chevrolet Tracker	1996-2004	N

20338-20339 Chevrolet Equinox	2005	curtain 38
	2006	curtain 25
	2007	rollover curtain 21
	2008	rollover curtain 29
	2009	rollover curtain S
	2010-2011	rollover curtain plus torso S
20342-20347 Chev Avalanche	2002-2005	torso S
	2006	torso 36
	2007	rollover curtain 59
	2008-2009	rollover curtain S
	2010-2011	rollover curtain plus torso S
20402 Chevrolet Astro Van	1996-2005	N
20410-20436 Chevrolet G Van	thru 2007	N
	2008	rollover curtain 16 (based on Ward's for GMC van)
	2009	rollover curtain 17
	2010	rollover curtain if V7=D,F
	2011	rollover curtain if V7=F,H
20440-42 Chev Lumina APV	1996	N
20452-57 Chevrolet Venture	1997	N
	1998-2000	torso S
	2001-2002	combo S for driver, torso S for RF
	2003	combo 99 for driver, torso 99 for RF
	2004	combo 91 for driver, torso 91 for RF
	2005	combo 83 for driver, torso 83 for RF
20452-57 Chevrolet Uplander	2005	combo 82
	2006	combo 43
	2007	combo 38
	2008	combo 37
21002 Olds Delta 88	1996-1999	N
21003 Olds 98	1996	N
21017 Olds Ciera	1996	N
21020 Olds Supreme	1996-1999	N
21021 Olds Alero	1996-2004	N
21022 Olds Aurora	thru 1999	N
	2000	[no Aurora]
	2001-2003	torso S
21023 Olds Intrigue	1998-2002	N
21302-21303 Olds Bravada	thru 2001	N
	2002-2004	torso S
21452-21457 Olds Silhouette	thru 1997	N
	1998-2000	torso S
	2001-2004	combo S for driver, torso S for RF

22002 Pontiac Bonneville	thru 1999	N
	2000-2002	torso S
	2003-2005	torso if V7=4
22008 Pontiac GTO	2004-2006	N
22009 Pontiac Firebird	1996-2002	N
22016 Pontiac Sunfire	thru 2002	N
	2003-2005	torso if V7=4
22018 Pontiac Grand Am	1996-2005	N
22019 Pontiac G5	2007	curtain if V7=8
	2008-2009	curtain S
22020 Pontiac Grand Prix	2000-2003	N
	2004-2005	curtain if V7=4
	2006-2008	curtain if V7=8
22022 Pontiac G6	2005	curtain if V7=4 (a very few may also have torso)
	2006-2007	curtain if V7=8, torso if V7=6, curt+torso if V7=7
	2008-2009	torso S on CV, curtain plus torso S on 2CP and 4SD
	2010	curtain plus torso S
22023 Pontiac Solstice	2006-2009	N
22024 Pontiac G8	2008-2009	curtain plus torso S
22025 Pontiac G3	2009	combo S
22032 Pontiac Vibe	2003-2004	torso if V7=4
	2005	curtain plus torso if V7=4,6
	2006-2008	curtain plus torso if V7=7
	2009-2010	curtain plus torso S
22338-22339 Pontiac Torrent	2006	curtain 23
	2007	rollover curtain 23
	2008	rollover curtain 18
	2009	rollover curtain S
22352-22353 Pontiac Aztek	2001-2002	combo S for driver, torso S for RF
	2003	combo 70 for driver, torso 70 for RF
	2004	combo 53 for driver, torso 53 for RF
	2005	combo 27 for driver, torso 27 for RF
22442-46 Pontiac Trans Sport	thru 1997	N
	1998	torso S
22452-57 Pont Montana (not SV6)	1999-2000	torso S
	2001-2002	combo S for driver, torso S for RF
	2003	combo 95 for driver, torso 95 for RF
	2004	combo 74 for driver, torso 74 for RF
	2005	combo 60 for driver, torso 60 for RF
22452-57 Pontiac Montana SV6	2005	combo 44
	2006	combo 16

23008 GMC Acadia	2007-2011	rollover curtain plus torso S
23200-05 GMC Sonoma/Canyon	thru 2003	N
	2004	curtain 12
	2005	curtain 8
	2006-2007	curtain 5
	2008	curtain 8
	2009	curtain 13
	2010-2011	curtain S
23210-15 GMC Sierra 1500	thru 2006	N
	2007	rollover curtain < 1
	2008	rollover curtain 13
	2009	rollover curtain 10
	2010-2011	rollover curtain plus torso S
23220-25 GMC Sierra 2500	thru 2010	N
	2011	torso if V7=D; curtain if V7=F,H; C+T if V7=E
23230-35 GMC Sierra 3500	1996-2011	N
23300-23303 GMC Jimmy	1996-2001	N
23302-23307 GMC Envoy	2002	torso S
	2003	torso 49
	2004	torso 30
	2005	rollover curtain 12
	2006	rollover curtain 30
	2007	rollover curtain 27
	2008-2009	rollover curtain S
23310-23319 GMC Yukon	thru 1999	N
	2000-2002	torso S
	2003	torso 37 (but S on Denali)
	2004	torso 39 (but S on Denali)
	2005	torso 33 (but S on Denali)
	2006	torso 77
	2007-2009	rollover curtain S
	2010-2011	rollover curtain+torso S
		(V6=F,G [hybrid] is rollover curtain only)
23322-23229 GMC Yukon XL	thru 1999	N
	2000-2002	torso S
	2003	torso 60
	2004	torso 77
	2005	torso 60
	2006	torso 79
	2007	rollover curtain 84
	2008-2009	rollover curtain S
	2010-2011	rollover curtain plus torso S
23338-23339 GMC Terrain	2010-2011	rollover curtain plus torso S
23404-23407 GMC Safari	1996-2005	N

23410-23436 GMC Savana	thru 2007	N
	2008	rollover curtain 16
	2009	rollover curtain 17
	2010	rollover curtain if V7=D,F
	2011	rollover curtain if V7=F,H
24001-24003 Saturn S	thru 2000	N
	2001-2002	curtain if V7=4
24004 GM EV1 (electric)	1997-1999	N
24005 Saturn L	2000	N
	2001	curtain if V7=4
	2002-2005	curtain S
24007 Saturn Ion	2003-2005	curtain if V7=4
	2006-2007	curtain if V7=8
24008 Saturn Sky	2007-2009	N
24009 Saturn Aura	2007-2009	curtain plus torso S
24010 Saturn Outlook	2007-2010	rollover curtain plus torso S
24011 Saturn Astra	2008-2009	curtain plus torso S
24362-24366 Saturn Vue	2002-2003	curtain 19
	2004	curtain 30
	2005	curtain 31
	2006	rollover curtain 32
	2007	rollover curtain 37
	2008-2010	rollover curtain plus torso S
24454-24457 Saturn Relay	2005	combo 48
	2006	combo 81
	2007	combo 76
30036 VW Rabbit	2006-2009	curtain plus torso S
30040 VW Jetta	thru 1997	N
	1998	torso if V6=6
	1999	torso S in cg 30010; torso if V6=2,6 in cg 30006
	2000	torso S
	2001-2011	curtain plus torso S
30042 VW Golf/GTI	thru 1997	N
	1998	torso if V6=6
	1999	torso S in cg 30010; torso if V6=2,6 in cg 30006
	2000	torso S
	2001-2011	curtain plus torso S
30043 VW Cabrio	thru 1997	N
	1998	torso if V6=6
	1999	torso if V6=2,6
	2000-2002	torso S
30046 VW Passat	thru 1997	N
	1998-2000	torso S
	2001-2011	curtain plus torso S

30047 VW Beetle	1998-2003	torso S
	2004-2010	combo S
30048 VW Phaeton	2004-2006	curtain plus torso S
30051 VW Eos	2007-2011	combo S
30302-30303 VW Tiguan	2009-2011	rollover curtain plus torso S
30313 VW Touareg	2004-2007	curtain plus torso S
	2008-2011	rollover curtain plus torso S
30406 VW Routan	2009-2010	rollover curtain S
	2011	rollover curtain plus torso S
30412 VW Eurovan	1997-2004	N

32040 Audi S4/S6	2002	combo S on CV, curtain plus torso S on others
32041 Audi Cabriolet	1996-1998	N
32042 Audi A6	thru 1997	N
	1998-1999	torso S
	2000	curtain plus torso if V6=4,5,6; torso if V6=2
	2001-2009	curtain plus torso S
32043 Audi A4	thru 1997	N
	1998-1999	torso S
	2000	curtain plus torso if V6=4,5,6; torso if V6=2
	2001-2009	combo S on CV, curtain plus torso S on others
32044 Audi A8	1997-1999	torso S
	2000-2009	curtain plus torso S
32045 Audi TT	2000-2011	combo S
32046 Audi S8	2001-2009	curtain plus torso S
32047 Audi Allroad	2001-2005	curtain plus torso S
32048 Audi A3	2006-2011	curtain plus torso S
32049 Audi A5	2008-2011	combo S on CV, curtain plus torso S on others
32050 Audi R8	2008-2011	combo S
32052 Audi S5	2008-2011	curtain plus torso S
32303 Audi Q5	2009-2011	rollover curtain plus torso S
32313 Audi Q7	2007-2011	rollover curtain plus torso S

33035 Mini-Cooper	2002-2011	combo S on CV, curtain plus torso S on others

34034 BMW 300	1996-1997	N
	1998	torso < 1 on 3HB; torso S on all others
	1999	torso S on CV, 2CP, 3HB; curtain+torso S on others
	2000-2009	torso S on CV and 3HB, curtain+torso S on others
	2010-2011	combo S on CV, curtain plus torso S on others
34035 BMW 500	1996	[no BMW 500]
	1997	torso S
	1998-2009	curtain plus torso S
	2010-2011	rollover curtain plus torso S on GT (CG 34033) curtain plus torso S on others
34036 BMW 600	2004-2010	torso S on CV, curtain plus torso S on others

34037 BMW 700	1996	N
	1997	torso S
	1998-2010	curtain plus torso S
	2011	rollover curtain plus torso S
34038 BMW 850	1996-1997	N
34039 BMW Z3	1996-1998	N
	1999-2002	torso S
34040 BMW Z8	2000-2003	torso S
34042 BMW Z4	thru 2009	torso S
	2010-2011	combo S
34043 BMW 100	2008-2011	combo S on CV, curtain plus torso S on others
34044 BMW X6	2008-2011	curtain plus torso S
34303 BMW X3	2004-2010	curtain plus torso S
	2011	rollover curtain plus torso S
34313 BMW X5	2000-2007	curtain plus torso S
	2008-2011	rollover curtain plus torso S
35032 Nissan 200/240SX	1996-1998	N
35034 Nissan 300ZX	1996	N
35039 Nissan Maxima	thru 1997	N
	1998-1999	torso if V8=A
	2000-2003	combo if V8=A
	2004-2011	curtain plus torso S
35043 Nissan Sentra	thru 1999	N
	2000-2006	combo if V8=A
	2007-2011	curtain plus torso S
35047 Nissan Altima	thru 1999	N
	2000-2001	combo if V8=A
	2002-2006	curtain plus torso if V8=E
	2007-2011	curtain plus torso S
35048 Nissan 350/370Z	2003-2007	curtain plus torso if V8=E, torso if V8=A
	2008	curtain plus torso if V8=E on 2CP, torso S on CV
	2009-2011	curtain plus torso S on 2CP, torso S on CV
35049 Nissan Murano	2003-2004	curtain plus torso S
	2005-2011	rollover curtain plus torso S
35050 Nissan Versa	2007-2011	curtain plus torso S
35051 Nissan Rogue CUV	2008-2011	rollover curtain plus torso S
35052 Nissan Cube CUV	2009-2011	curtain plus torso S
35053 Nissan GT-R	2009	curtain plus torso if V8=F
	2010-2011	curtain plus torso S
35055 Nissan Leaf	2011	curtain plus torso S

35200-35205 Nissan Frontier	thru 2004	N
	2005	rollover curtain plus torso 10
	2006	rollover curtain plus torso 11
	2007	rollover curtain plus torso 3
	2008	rollover curtain plus torso 6
	2009	rollover curtain plus torso 4
	2010-2011	rollover curtain plus torso S
35212-35215 Nissan Titan	2004	curtain plus torso 13
	2005	rollover curtain plus torso 7
	2006	rollover curtain plus torso 7
	2007	rollover curtain plus torso 5
	2008	rollover curtain plus torso 3
	2009	rollover curtain plus torso 5
	2010-2011	rollover curtain plus torso S
35240-35247 Nissan pickup	1996-1997	N
35300-35303 Nissan Pathfinder	thru 1998	N
	1999	combo < 1
	2000	combo 75
	2001	combo 56
	2002	combo 58
	2003	curtain plus torso 38
	2004	curtain plus torso 49
	2005	rollover curtain plus torso 39
	2006	rollover curtain plus torso 16
	2007	rollover curtain plus torso 21 (avg of 2006 & 2008)
	2008	rollover curtain plus torso 25
	2009	rollover curtain plus torso S
	2010-2011	rollover curtain plus torso S
35312-35313 Nissan Armada	2004	rollover curtain S, torso 74
	2005	rollover curtain S, torso 74
	2006	rollover curtain S, torso 100
	2007	rollover curtain S, torso 48
	2008	rollover curtain S, torso 52
	2009	rollover curtain S, torso 56
	2010-2011	rollover curtain plus torso S
35322-35323 Nissan Xterra	thru 2002	N
	2003	curtain 5
	2004	curtain 68
	2005	rollover curtain plus torso 6
	2006	rollover curtain plus torso 8
	2007	rollover curtain plus torso 5
	2008	rollover curtain plus torso 10
	2009	rollover curtain plus torso S
	2010-2011	rollover curtain plus torso S
35332-35333 Nissan Juke	2011	curtain plus torso S

35452 Nissan Quest	thru 2002	N
	2003	[no Quest]
	2004	curtain S, torso < 1
	2005	curtain S, torso < 1
	2006	curtain S, torso 12
	2007	curtain S, torso 30
	2008-2011	curtain plus torso S
37030 Honda Civic Del Sol	1996-1997	N
37031 Honda Civic	thru 2000	N
	2001	torso 17
	2002	torso 13
	2003-2004	torso 10 (but S on hybrid)
	2005	torso 15 (but S on hybrid)
	2006-2011	curtain plus torso S
37032 Honda Accord	thru 1999	N
	2000	torso 53
	2001	torso 69
	2002	torso 58
	2003	complex VIN decode
	2004	complex VIN decode
	2005-2009	curtain plus torso S
	2010-2011	roll curt plus torso S on Crosstour (CG 37309)
		curtain plus torso S on others
37033 Honda Prelude	1996-2001	N
37035 Honda S2000	2000-2009	N
37036 Honda EV Plus	1997-1999	N
37037 Honda Insight	2000-2009	N
	2010-2011	curtain plus torso S
37039 Honda Fit	2007-2011	curtain plus torso S
37041 Honda CR-Z	2011	curtain plus torso S
37205 Honda Ridgeline	2006-2011	rollover curtain plus torso S
37302-37303 Honda CR-V	thru 2001	N
	2002-2004	torso if V8=5,8
	2005-2011	rollover curtain plus torso S
37322-37323 Honda Passport	1996-2002	N
37322-37323 Honda Pilot	2003-2005	torso S
	2006-2011	rollover curtain plus torso S
37332-37333 Honda Element	2003-2006	torso if V8=6,7
	2007-2011	rollover curtain plus torso S
37402 Honda Odyssey	thru 2001	N
	2002-2004	torso S
	2005-2011	rollover curtain plus torso S

38202-38205 Isuzu Pickups	thru 2000	N
	2001-2005	[no Isuzu pickups]
	2006	curtain 20
	2007	curtain 33
	2008	curtain 20
38300-38301 Isuzu Rodeo Sport	1998-2003	N
38302-38307 Isuzu Ascender	2003	torso S
	2004	torso 100
	2005	rollover curtain 30
	2006	rollover curtain 31
	2007	rollover curtain 25
	2008	rollover curtain S
38311-38313 Isuzu Trooper	1996-2002	N
38322-38323 Isuzu Rodeo	1996-2004	N
38326-38327 Isuzu Axiom	2002-2004	N
38331 Isuzu Vehicross	1999-2002	N
38402 Isuzu Oasis	1996-1999	N
39031 Jaguar XK (incl 39035)	thru 2000	N
	2001-2011	combo S
39032 Jaguar XJ	thru 1997	N
	1998-2003	torso S
	2004-2011	curtain plus torso S
39034 Jaguar S Type	2000-2002	combo S
	2003-2007	curtain plus torso S
39036 Jaguar X Type	2002-2008	curtain plus torso S
39037 Jaguar XF	2009-2011	curtain plus torso S
41035 Mazda Protégé	thru 1999	N
	2000-2003	combo if V8=3,4,6,8
41037 Mazda 626	thru 1999	N
	2000-2002	combo if V8=E,F
41044 Mazda MX-6	1996-1997	N
41045 Mazda Miata/MX-5	thru 2005	N
	2006-2011	combo S
41047 Mazda Millenia	thru 2000	N
	2001-2002	combo S
41049 Mazda RX-8	2004-2011	curtain plus torso S
41050 Mazda 6	2003-2005	curtain plus torso if V4=H
	2006-2007	curtain plus torso if V4=H, curtain if V4=G
	2008-2011	curtain plus torso S
41051 Mazda 3	2004-2007	curtain plus torso if V46=BK3, curtain if V46=BK2
	2008-2011	curtain plus torso if V46=BK3
41052 Mazda 5	2006-2007	curt+torso if V48=CR29L, curtain if V48=CR293
	2008-2010	curtain plus torso S
41053 Mazda CX-7	2007-2011	rollover curtain plus torso S

41054 Mazda CX-9	2007-2011	rollover curtain plus torso S
41055 Mazda 2	2011	curtain plus torso S
41200-41205 Mazda B pickup	1996-2009	N
41342-41347 Mazda Tribute	2001-2004	combo if V4=C
	2005	rollover curtain if V4=C
	2006	rollover curtain plus torso if V4=C
	2007	[no Mazda Tribute]
	2008-2011	rollover curtain plus torso S
41402-41403 Mazda MPV	thru 1999	N
	2000	combo 0 [optional, but probably very few]
	2001	combo if V8=Y
	2002-2006	combo if V8=J
42042 Mercedes C	thru 1997	N
	1998-2000	torso S
	2001-2011	curtain plus torso S
42043 Mercedes S	1996	N
	1997-1999	torso S
	2000-2002	curtain plus torso S
	2003-2011	rollover curtain plus torso S
42044 Mercedes SL	1996	N
	1997-2002	torso S
	2003-2011	combo S
42045 Mercedes SLK	1996	N
	1997-2004	torso S
	2005-2011	combo S
42046 Mercedes CL	1998-2000	torso S
	2001-2002	curtain plus torso S
	2003-2011	rollover curtain plus torso S
42047 Mercedes CLK	1998-2002	torso S
	2003	torso S on CV, curtain plus torso S on 2CP
	2004-2007	combo S on CV, curtain plus torso S on 2CP
	2008-2009	combo S on CV
		rollover curtain plus torso S on 2CP
42048 Mercedes E	1996	N
	1997-1998	torso S
	1999-2002	curtain plus torso S
	2003-2011	rollover curtain plus torso S
		[CV has head bag instead of curtain]
42049 Mercedes SLR	2005-2009	combo S
42051 Mercedes CLS	2006-2011	rollover curtain plus torso S
42052 Mercedes SLS	2011	curtain [head bag] plus torso S
42302-42307 Mercedes ML	1998-2001	torso S
	2002-2005	curtain plus torso S
	2006-2011	rollover curtain plus torso S
42313 Mercedes G	2002-2011	curtain S

42323 Mercedes R	2006-2011	rollover curtain plus torso S
42333 Mercedes GL	2007	curtain plus torso S
	2008-2011	rollover curtain plus torso S
42336-42337 Mercedes GLK	2010-2011	rollover curtain plus torso S
45031 Porsche 911	thru 1998	N
	1999	torso S
	2000-2001	combo S
	2002-2004	torso S
	2005-2011	curtain plus torso S [CV head bag instead of curt]
45040 Porsche Boxster	thru 1997	N
	1998-1999	torso S
	2000-2001	combo S
	2002-2004	torso S
	2005-2011	curtain plus torso S [CV head bag instead of curt]
45041 Porsche Cayman	2006-2011	curtain plus torso S [CV head bag instead of curt]
45042 Porsche Panamera	2010-2011	rollover curtain plus torso S [CV head bag instead of curtain]
45313 Porsche Cayenne	2004-2007	curtain plus torso S
	2008-2011	rollover curtain plus torso S
47031 Saab 900	1996-1998	N
47034 Saab 9000	1996-1998	N
47035 Saab 9-3	1999-2002	combo S
	2003-2007	combo S on CV, curtain plus torso S on others
	2008-2011	combo S on CV curtain (unk if roll curt) plus torso S on others
47036 Saab 9-5	CG 47007	combo S
	CG 47009	rollover curtain plus torso S
47037 Saab 9-2X	2005-2006	combo S
47038 Saab 9-4X	2011	rollover curtain plus torso S
47308 Saab 9-7X	2005-2009	rollover curtain S
48034 Subaru Legacy	thru 1999	N
	2000-2004	torso if V8=6
	2005-2011	curtain plus torso S
48037 Subaru SVX	1996-1997	N
48038 Subaru Impreza	thru 2001	N
	2002-2004	torso if V8=6
	2005	combo if V8=6
	2006-2007	combo S
	2008-2011	curtain plus torso S
48044 Subaru Baja	2003-2006	N
48045 Subaru Outback	2003-2004	torso if V8=6
	2005-2009	curtain plus torso S
	2010-2011	rollover curtain plus torso S

48303 Subaru Forester	thru 2000	N
	2001-2002	torso if V8=6
	2003-2008	combo S
	2009-2011	rollover curtain plus torso S
48313 Subaru Tribeca	2006-2011	rollover curtain plus torso S
49032 Toyota Corolla	thru 1997	N
	1998-2004	torso if V7=8
	2005-2008	curtain plus torso if V7=0
	2009-2011	curtain plus torso S
49033 Toyota Celica	thru 1999	N
	2000-2005	torso if V7=8
49034 Toyota Supra	1996-1998	N
49038 Toyota Tercel	1996-1998	N
49040 Toyota Camry	thru 1997	N
	1998-2001	torso if V7=8
	2002-2006	curtain plus torso if V7=0
	2007-2011	curtain plus torso S
49041 Toyota MR2	1996-2005	N
49042 Toyota Paseo	1996-1997	N
49043 Toyota Avalon	thru 1997	N
	1998-2004	torso S
	2005-2011	curtain plus torso S
49044 Toyota Camry Solara	1999-2003	torso if V7=8
	2004-2009	curtain plus torso if V7=0, torso if V7=8
49045 Toyota Echo	2000-2006	torso if V7=8
49046 Toyota Prius	2001-2003	torso if V7=8
	2004-2006	curtain plus torso if V7=0
	2007-2011	curtain plus torso S
49047 Toyota Matrix	2003-2004	torso if V7=8
	2005-2008	curtain plus torso if V7=0
	2009-2011	curtain plus torso S
49048 Scion xA	2004-2006	curtain plus torso if V7=0
49049 Scion xB	2004-2006	N
	2007	[no Scion xB]
	2008-2011	curtain plus torso S
49050 Scion tC	2005-2007	curtain plus torso if V7=6
	2008-2011	curtain plus torso S
49051 Toyota Yaris	2007-2008	curtain plus torso if V7=0
	2009-2011	curtain plus torso S
49052 Scion xD	2008-2011	curtain plus torso S
49053 Toyota Venza CUV	2009-2011	curtain plus torso S

49200-49205 Toyota Tacoma Pk	thru 2004	N
	2005	curtain plus torso 3
	2006	curtain plus torso 5
	2007-2008	rollover curtain plus torso 5
	2009-2011	rollover curtain plus torso S
49210-49215 Toyota Tundra Pk	thru 2004	N
	2005	rollover curtain plus torso 11
	2006	rollover curtain plus torso 14
	2007	rollover curtain plus torso 13
	2008-2011	rollover curtain plus torso S
49250-49258 Toyota T100 Pk	1996-1998	N
49302-49303 Toyota 4Runner	thru 2002	N
	2003	curtain plus torso 20
	2004	rollover curtain plus torso 20
	2005	rollover curtain plus torso 23
	2006	rollover curtain plus torso 72
	2007	rollover curtain plus torso 73
	2008-2011	rollover curtain plus torso S
49313 Toyota Land Cruiser	thru 2002	N
	2003	rollover curtain plus torso 30
	2004	rollover curtain plus torso 100
	2005	rollover curtain plus torso 99
	2006	rollover curtain plus torso 99
	2007	rollover curtain plus torso 81
	2008-2011	rollover curtain plus torso S
49322-49323 Toyota RAV4	thru 2003	N
	2004	curtain plus torso 0
	2005	curtain plus torso 34
	2006	rollover curtain plus torso 63
	2007	rollover curtain plus torso 36
	2008-2011	rollover curtain plus torso S
49342-49347 Toyota Highlander	2001	torso 33
	2002	torso 41
	2003	torso 42
	2004	curtain plus torso 45
	2005	rollover curtain plus torso 45
	2006	rollover curtain plus torso 62
	2007-2011	rollover curtain plus torso S
49352-49353 Toyota Sequoia	2001	curtain plus torso 0
	2002	curtain plus torso 0
	2003	curtain plus torso 0
	2004	curtain plus torso 75
	2005	rollover curtain plus torso 80
	2006	rollover curtain plus torso 13
	2007	rollover curtain plus torso 86
	2008-2011	rollover curtain plus torso S

49362-49363 Toyota FJ Cruiser	2007	curtain plus torso 44
	2008	curtain plus torso S
	2009-2011	rollover curtain plus torso S
49402-49303 Toyota Sienna Van	thru 2000	N
	2001	torso 0
	2002	torso 0
	2003	torso 0
	2004	curtain plus torso 56
	2005	curtain plus torso 61
	2006	curtain plus torso 100
	2007	curtain plus torso 99
	2008-2011	curtain plus torso S
49422 Toyota Previa Van	1996-1997	N
51041 Volvo 960	1996-1997	torso S
51042 Volvo 850	1996-1997	torso S
51043 Volvo 70, XC70	1998	torso S
	1999	torso S on CV and 2CP, combo S on others
	2000	combo S
	2001-2004	combo S on CV, 2CP; curtain plus torso on others
	2005	curtain plus torso S
	2006-2011	rollover curtain plus torso S on CV curtain plus torso S on others
51044 Volvo 90-Series	1998	torso S
51045 Volvo S80	1999-2011	curtain plus torso S
51046 Volvo 40	2000	combo S
	2001-2011	curtain plus torso S
51047 Volvo S60, XC60	2001-2009	curtain plus torso S
	2010-2011	rollover curtain plus torso S
51048 Volvo V50	2005-2011	curtain plus torso S
51049 Volvo C30	2008-2011	curtain plus torso S
51312-51313 Volvo XC90	2003-2011	rollover curtain plus torso S
52034 Mitsubishi Galant	thru 1998	N
	1999	torso 22
	2000	torso 14
	2001	torso 13
	2002-2003	torso 11
	2004	torso 14
	2005-2006	combo S
	2007-2011	curtain plus torso S
52035 Mitsubishi Mirage	1996-2002	N

52037 Mitsubishi Eclipse	1996-1999	N
	2000	torso 11
	2001	torso 32
	2002	torso 23
	2003-2005	torso if V6=7
	2006-2011	combo S on CV; curtain plus torso on others
52039 Mitsubishi 3000GT	1996-1997	N
52040 Mitsubishi Diamante	1996-2004	N
52046 Mitsubishi Lancer	2002	torso 0
	2003	torso 0
	2004	torso 6
	2005	torso 10
	2006	torso 10
	2007	torso 10
	2008-2011	curtain plus torso S
52047 Mitsubishi Outlander	2003	torso 0
	2004	torso 33
	2005	torso 14
	2006	torso 100
	2007-2011	rollover curtain plus torso S
52202 Mitsubishi Raider	2006	curtain 9
	2007-2009	curtain 0 (optional but Ward's says zero)
52240 Mitsubishi Mighty Max	1996	N
52312-13 Mitsubishi Endeavor	2004	torso 100
	2005-2006	torso S
	2007-2008	rollover curtain plus torso S
	2009	[no Endeavor]
	2010-2011	rollover curtain plus torso S
52333 Mitsubishi Montero	thru 2000	N
	2001-2006	torso S
52336-37 Mits Montero Sport	1997-2004	N
53031 Suzuki Swift	1996-2001	N
53032 Suzuki Esteem	1996-2002	N .
53033 Suzuki Aerio	2002-2004	N
	2005-2007	torso S
53034 Suzuki Forenza	2004	N
	2005-2008	combo S
53035 Suzuki Verona	2004	N
	2005-2006	combo S
53036 Suzuki Reno	2005-2008	combo S
53040 Suzuki SX4	2007-2011	curtain plus torso S
53202-53205 Suzuki Equator Pk	2009-2011	rollover curtain plus torso S
53310-53313 Suzuki Sidekick	1996-1998	N
53320-53321 Suzuki X-90	1996-1998	N
53332-53333 Suzuki Vitara	1999-2004	N

53336-37 Suzuki Grand Vitara	2000-2005	N
	2006-2008	curtain plus torso S
	2009-2011	rollover curtain plus torso S
53338-58339 Suzuki XL-7	2001-2006	N
	2007-2009	rollover curtain S
	2010-2011	rollover curtain plus torso S
54031 Acura Integra	1996-2001	N
54033 Acura NSX	1996-2005	N
54035 Acura TL	thru 1999	N
	2000-2003	torso S
	2004-2011	curtain plus torso S
54036 Acura RL	thru 1998	N
	1999-2004	torso S
	2005-2011	curtain plus torso S
54037 Acura CL	thru 1999	N
	2000-2003	torso S
54038 Acura RSX	2002-2006	torso S
54039 Acura TSX	2004-2011	curtain plus torso S
59040 Acura ZDX	2010-2011	rollover curtain plus torso S
54302-54303 Acura RDX	2007-2011	rollover curtain plus torso S
54313 Acura SLX	1996-1999	N
54323 Acura MDX	2001-2003	torso S
	2004-2011	rollover curtain plus torso S
55033 Hyundai Sonata	thru 1998	N
	1999-2000	torso S
	2001-2005	combo S
	2006-2011	curtain plus torso S
55035 Hyundai Elantra	thru 2000	N
	2001-2006	combo S
	2007-2011	curtain plus torso S
55036 Hyundai Accent	thru 2002	N
	2003	combo 0
	2004	combo 0
	2005	combo S
	2006-2011	curtain plus torso S
55037 Hyundai Tiburon	thru 2002	N
	2003-2005	combo S
	2006	combo 100
	2007-2008	combo 100
55038 Hyundai XG300	2001-2005	combo S
55039 Hyundai Azera	2006-2011	curtain plus torso S
55040 Hyundai Equus	2011	curtain plus torso S
55041 Hyundai Genesis	2009-2011	curtain plus torso S

55302 Hyundai Santa Fe	2001	N
	2002	combo 0
	2003-2006	combo S
	2007-2010	curtain plus torso S
	2011	rollover curtain plus torso S
55322-55323 Hyundai Tucson	2005-2009	curtain plus torso S
	2010-2011	rollover curtain plus torso S
55332-55333 Hyundai Veracruz	2007-2011	curtain plus torso S
55402 Hyundai Entourage	2007-2009	curtain plus torso S
58032 Infiniti Q45	1996	N
	1997	torso if V8=A
	1998	torso S
	1999-2001	combo S
	2002-2006	curtain plus torso S
58033 Infiniti G20	thru 1998	N
	1999-2002	combo S
58034 Infiniti J30	1996-1997	N
58035 Infiniti I30	thru 1997	N
	1998-1999	torso S
	2000-2001	combo S
58036 Infiniti I35	2002-2004	combo S
58037 Infiniti G35	2003-2011	curtain plus torso S
58038 Infiniti M45	2003-2011	curtain plus torso S
58039 Infiniti FX35	2003-2004	curtain plus torso S
	2005-2011	rollover curtain plus torso S
58040 Infiniti EX35 CUV	2008-2011	curtain plus torso S
58302-58303 Infiniti QX4	thru 1998	N
	1999-2003	combo S
58312-58313 Infiniti QX56	2004-2011	rollover curtain plus torso S
59031 Lexus ES	thru 1997	N
	1998-2001	torso S
	2002-2011	curtain plus torso S
59032 Lexus LS	1996	N
	1997-2000	torso S
	2001-2011	curtain plus torso S
59033 Lexus SC-300/400	1993-2000	N
59034 Lexus GS	thru 1997	N
	1998-2000	torso S
	2001-2011	curtain plus torso S
59035 Lexus IS	2001	torso S
	2002-2009	curtain plus torso S
	2010-2011	combo S on CV, else curtain plus torso S
59036 Lexus SC-430	2002-2010	torso S
59037 Lexus HS	2010-2011	curtain plus torso S
59038 Lexus CT	2011	curtain plus torso S

59303 Lexus GX	2003	curtain plus torso S
	2004-2011	rollover curtain plus torso S
59313 Lexus LX	thru 2002	N
	2003-2011	rollover curtain plus torso S
59332-59333 Lexus RX300	1999-2003	torso S
59342-59343 Lexus RX330	2004	curtain plus torso S
	2005-2011	rollover curtain plus torso S
62303,07 Land Rover Discovery	1996-2004	N
62313 Land Rover Range Rover	thru 1999	N
	2000-2002	torso S
	2003-2010	curtain plus torso S
	2011	rollover curtain plus torso S
62317 L. R. Range Rover Sport	2006-2011	rollover curtain plus torso S
62325 Land Rover Defender	1997	N
62341,43 Land Rover Freelander	2002-2005	N
62353 Land Rover LR3/LR4	2005-2011	rollover curtain plus torso S
62357 Land Rover LR2	2008-2011	rollover curtain plus torso S
63031 Kia Sephia	1996-2001	N
63032 Kia Rio	2001-2005	N
	2006-2011	curtain plus torso S
63033 Kia Spectra	2000-2003	N
	2004	N on CG 63005, curtain plus torso S on CG 63008
	2005-2009	curtain plus torso S
63034 Kia Optima	2001-2005	combo S
	2006	combo S on CG 55005, curt+tors S on CG 63009
	2007-2009	curtain plus torso S
	2010	[no Optima]
	2011	curtain plus torso S
63035 Kia Amanti	2004-2009	curtain plus torso S
63036 Kia Rondo	2007-2010	torso S
	2011	curtain plus torso S
63037 Kia Soul	2010-2011	curtain plus torso S
63038 Kia Forte	2010-2011	curtain plus torso S
63302-63303 Kia Sportage	1998-2002	N
	2003-2004	[no Sportage]
	2005-2010	curtain plus torso S
	2011	rollover curtain plus torso S
63312-63313 Kia Sorento	2003-2009	curtain S
	2010	[no Sorento]
	2011	rollover curtain plus torso S
63316-63317 Kia Borrego	2009	rollover curtain plus torso S
63402 Kia Sedona	2002-2005	N
	2006-2011	curtain plus torso S
64... Daewoo		N

65031 Smart Fortwo	2008-2010	combo S
	2011	combo S on CV, curtain plus torso S on 2CP

Appendix B

Make-Models in the Contingency-Table and FARS-GES Analyses

These models either (1) shifted directly from having no side air bags of any type to having standard curtain plus torso bags or (2) had, in some MY, a VIN-identifiable mix of vehicles including some with no side air bags and some with curtain plus torso bags.* The numeric codes shown before the make-model names are the ones assigned by the VIN-decode programs developed by NHTSA's Evaluation Division (see Appendix A). Models are included for a range of at most six MY; the range may be further truncated (and in a few cases expanded), if necessary, to have approximately twice as many cases without any side air bags as cases with curtain plus torso bags. The range is also truncated, if necessary, to assure that the annual percentages of vehicles equipped with ESC do not vary by more than 10 percentage points.

Make-Model	MY Without Side Air Bags	Mix of None & Curtain + Torso	MY With All Curtain + Torso
6043 Chrysler Sebring Sedan		2004-2006	2007-2009
6051 Chrysler 300		2008-2009	2010-2011
7024 Dodge Charger		2008-2009	2010-2011
12017 Ford Taurus (car)			2008
12021 Ford 500		2005-2007	
14017 Mercury Sable			2008
14020 Mercury Montego		2005-2007	
12017 Ford Taurus X (CUV)			2008-2009
12022 Ford Freestyle		2005-2007	
12023 Ford Fusion		2006	
14021 Mercury Milan		2006	
12037 Ford Focus	2005-2007*		2008-2009
12342-12347 Ford Escape	2005*	2006-2007	
14342-14347 Mercury Mariner		2005-2007	
41342-41347 Mazda Tribute	2005*	2006	
12400, 12402 Ford Freestar		2004-2007	
14402 Mercury Monterey		2004-2006	2007
20002 Chevrolet Impala	2006-2008*		2009
20037 Chevrolet Malibu	2005*	2006	

* Vehicles with combo, torso-only, or curtain-only bags are excluded from the analyses.

Make-Model	MY Without Side Air Bags	Mix of None & Curtain + Torso	MY With All Curtain + Torso
20210-15 Chev Silverado 1500	2009[†]		2010
23210-15 GMC Sierra 1500	2009[†]		2010
22022 Pontiac G6	2005-2007*		2008-2009*
22032 Pontiac Vibe		2005-2008	2009-2010
35039 Nissan Maxima	2000-2003*		2004-2006
35043 Nissan Sentra	2004-2006*		2007-2009
35047 Nissan Altima		2002-2006	2007-2008
37031 Honda Civic	2003-2005[†]		2006-2008
37032 Honda Accord		2003-2004*	
37332-37333 Honda Element	2006*		2007
41050 Mazda 6		2003-2007*	2008
41051 Mazda 3		2004-2009*	
48034 Subaru Legacy	2002-2004*		2005-2007
48035 Subaru Outback	2002-2004*		2005-2007
49032 Toyota Corolla		2006-2008	2009
49040 Toyota Camry		2003-2006	2007-2008
49046 Toyota Prius	2001-2003*	2004*	
49049 Scion xB	2004-2006		2008-2010
49050 Scion tC		2005-2007	2008
49051 Toyota Yaris		2007-2008	2009
49200-49205 Toyota Tacoma Pk	2007-2008[†]		2009-2011
52046 Mitsubishi Lancer	2006-2007[†]		2008-2009
55036 Hyundai Accent	2003-2004		2006-2008
59313 Lexus LX	2000-2002		2003-2005
63032 Kia Rio	2003-2005		2006-2008
63033 Kia Spectra	2001-2003	2004	2005-2007
63402 Kia Sedona	2005		2006

*Vehicles with combo, torso-only, or curtain-only bags are excluded from the analyses.

[†]A small proportion (3 to 15%) of these vehicles was known to be equipped with some type of optional side air bags, but individual vehicles cannot be identified by VIN; these are included in the group without side air bags.

Appendix C: Make-Models in the Contingency-Table Analyses of Rollover Curtains

These models either (1) shifted directly from not having rollover curtains to having standard rollover curtains or (2) had, in some MY, a VIN-identifiable mix of vehicles including some without and some with rollover curtains. However, aside from the shift to rollover curtains, these models vary in other equipment: they might have no side air bags at all, or torso bags, or combo bags at various times; they may or may not have had non-rollover curtains before they had the rollover curtains. The following list shows, for each model, what type of side air bags if any were present. The numeric codes shown before the make-model names are the ones assigned by the VIN-decode programs developed by NHTSA's Evaluation Division (see Appendix A). Models are included for a range of at most six MY; the range may be further truncated, if necessary, to have approximately twice as many cases without rollover curtains as cases with rollover curtains. The range is also truncated, if necessary, to assure that the annual percentages of vehicles equipped with ESC do not vary by more than 10 percentage points.

	Rollover Curtains			Other Side Air Bags	
Make-Model	MY Without	Mix	MY With	Without Roll Curt	With Roll Curt
2342, 2343 Jeep Liberty	2006-2007		2008-2010	Some non-roll curt	Roll curt only
3313, 3317 Hummer H2	2007		2008-2009	None	Roll curt only
7027 Dodge Journey	2009		2010-2011	Non-roll curt+torso	Roll curt+torso
7312, 7313 Dodge Durango		2004-2005		None	Roll curt only
12017 Ford Taurus (car)			2008		Roll curt+torso
12021 Ford 500		2005-2007		None	Roll curt+torso
14017 Mercury Sable			2008		Roll curt+torso
14020 Mercury Montego		2005-2007		None	Roll curt+torso
12017 Ford Taurus X (CUV)			2008-2009		Roll curt+torso
12022 Ford Freestyle		2005-2007		None	Roll curt+torso
12025 Ford Flex	2009		2010-2011	Non-roll curt+torso	Roll curt+torso
12300-12303, 12308 Ford Explorer		2002-2004		None	Roll curt only
14302-14308 Mercury Mountaineer		2002-2004		None	Roll curt only

	Rollover Curtains			Other Side Air Bags	
Make-Model	MY Without	Mix	MY With	Without Roll Curt	With Roll Curt
12312, 12313 Ford Expedition		2003-2006		None	Roll curt only
12342-12347 Ford Escape	2005	2006-2007		None	Some torso
14342-14347 Mercury Mariner		2005-2007		None	Some torso
41342-41347 Mazda Tribute	2005	2006		None	Some torso
12400, 12402 Ford Freestar		2004-2007		None	Roll curt+torso
14402 Mercury Monterey		2004-2006	2007	None	Roll curt+torso
19018 Cadillac CTS	2009		2010-2011	Non-roll curt+torso	Roll curt+torso
19020 Cadillac SRX	2004-2005		2006-2008	Non-roll curt+torso	Roll curt+torso
19312-19343 Cadillac Escalade	2004-2006		2007-2009	Torso only	Roll curt only
20210-15 Chevrolet Silverado 1500	2009†		2010	None†	Roll curt+torso
23210-15 GMC Sierra 1500	2009†		2010	None†	Roll curt+torso
20302-20307 Chevrolet Trailblazer	2007†		2008-2009	None†	Roll curt only
20312, 20313 Chevrolet Tahoe	2006		2008	Some torso	Roll curt only
23312, 23313, 23318 GMC Yukon	2006		2008	Some torso	Roll curt only
20322, 20323 Chev Suburban 1500	2006		2008	Some torso	Roll curt only
23322, 23323, 23328 Yukon XL 1500	2006		2008	Some torso	Roll curt only
20342, 20343 Chev Avalanche 1500	2006		2008	Some torso	Roll curt only
30313 Volkswagen Touareg	2005-2007		2008-2010	Non-roll curt+torso	Roll curt+torso
45313 Porsche Cayenne	2005-2007		2008-2010	Non-roll curt+torso	Roll curt+torso
34313 BMW X5	2006-2007		2008-2010	Non-roll curt+torso	Roll curt+torso

†A small proportion (4 to 20%) of these vehicles was known to be equipped with rollover curtains, but individual vehicles cannot be identified by VIN; these are included in the group without rollover curtains.

	Rollover Curtains			Other Side Air Bags	
Make-Model	MY Without	Mix	MY With	Without Roll Curt	With Roll Curt
35049 Nissan Murano	2004		2005	Non-roll curt+torso	Roll curt+torso
35200-35205 Nissan Frontier	2009†		2010	None†	Roll curt+torso
37332-37333 Honda Element	2006		2007	Some torso	Roll curt+torso
42043 Mercedes S	2000-2002		2003-2005	Non-roll curt+torso	Roll curt+torso
42046 Mercedes CL	2001-2002		2003-2005	Non-roll curt+torso	Roll curt+torso
42047 Mercedes CLK (coupe only)	2005-2007		2008-2010	Non-roll curt+torso	Roll curt+torso
42048 Mercedes E	2000-2002		2003-2005	Non-roll curt+torso	Roll curt+torso
48045 Subaru Outback	2009		2010	Non-roll curt+torso	Roll curt+torso
49200-49205 Toyota Tacoma Pk	2007-2008†		2009-2011	None†	Roll curt+torso
49362, 49363 Toyota FJ Cruiser	2008		2009-2011	Non-roll curt+torso	Roll curt+torso
51047 Volvo S60 and XC60	2009		2010-2011	Non-roll curt+torso	Roll curt+torso
53336, 53337 Suzuki Grand Vitara	2008		2009-2011	Non-roll curt+torso	Roll curt+torso
54323 Acura MDX	2003		2004-2005	Torso	Roll curt+torso
55322, 55323 Hyundai Tucson	2009		2010	Non-roll curt+torso	Roll curt+torso
58039 Infiniti FX	2003-2004		2005-2007	Non-roll curt+torso	Roll curt+torso
59303 Lexus GX	2003		2004	Non-roll curt+torso	Roll curt+torso
59313 Lexus LX	2000-2002		2003-2005	None	Roll curt+torso
59342, 59343 Lexus RX330	2004		2005-2006	Non-roll curt+torso	Roll curt+torso

†A small proportion (4 to 20%) of these vehicles was known to be equipped with rollover curtains, but individual vehicles cannot be identified by VIN; these are included in the group without rollover curtains.

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