

Status Report

Insurance Institute for Highway Safety | Highway Loss Data Institute

Small overlap challenge

New crash test taxes small car restraints, structure

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The latest small overlap front crash test results from the Institute reveal a range of performance among many of the best-selling small cars in the U.S. market. Of the 12 models evaluated, half earn a good or acceptable rating, while the other six earn a marginal or poor rating. The six best performers all qualify for the *TOP SAFETY PICK+* award.

The 2-door and 4-door models of the Honda Civic are the only small cars to earn the top rating of good in the test. IIHS evaluated the Civics earlier this year and released the results in March. The Dodge Dart, Ford Focus, Hyundai Elantra and 2014 model Scion tC earn acceptable.

The Civics, Dart, Elantra, Focus and tC earn the *TOP SAFETY PICK+* accolade. The Institute introduced the award in 2012 to recognize models with superior crash protection. So far, 25 models earn the top honor. The “plus” indicates good or acceptable performance in the small overlap test. Winners must earn good ratings for occupant protection in 4 of 5 evaluations and no less than acceptable in the fifth test. IIHS rates vehicles good, acceptable,

Small cars as a group fared better than small SUVs but worse than midsize moderately priced cars.

marginal or poor based on performance in a moderate overlap front crash, small overlap front crash, side impact and roll-over test, plus evaluations of seat/head restraints for protection against neck injuries in rear impacts.

The Institute added the small overlap front test to its lineup of vehicle evaluations last year. It replicates what happens when the front corner of a vehicle strikes another vehicle or an object like a tree or

a utility pole. In the test, 25 percent of a vehicle’s front end on the driver side strikes a 5-foot-tall rigid barrier at 40 mph. A 50th percentile male Hybrid III dummy is belted in the driver seat (see *Status Report*, Aug. 14, 2012, at iihs.org).

Small cars are the fourth group to be tested. All but the tC and Kia Forte are 2013 models. IIHS also has evaluated midsize luxury cars, midsize cars and small SUVs. Results for minicars will be released later this year.

As a group, small cars fared worse than their midsize moderately priced counterparts in the same test but better overall than small SUVs (see *Status Report*, May 30, 2013, and Dec. 20, 2012).

“The small cars with marginal or poor ratings had some of the same structural and restraint system issues as other models we’ve tested,” says David Zubly, the Institute’s chief research officer. “In the worst cases safety cages collapsed, driver airbags moved sideways with unstable steering columns and the dummy’s head hit the instrument panel. Side curtain airbags didn’t deploy or didn’t provide enough forward coverage to make a difference. All of this adds up to poor protection in a small overlap crash.”

Most new vehicles are designed to do well in the federal government’s full-width front crash test and in the Institute’s moderate overlap front test, but that is no guarantee of good performance in a small overlap crash. In a 2009 IIHS study of vehicles with good ratings for frontal crash protection, small overlap crashes accounted for nearly a quarter of the frontal crashes involving serious or fatal injury to front seat occupants. In many vehicles the impact at a 25 percent overlap misses the primary structures designed to manage



Significant occupant compartment intrusion contributed to the Nissan Sentra’s poor rating. The left front wheel and tire were forced rearward, pushing back the door hinge pillar and instrument panel toward the dummy and moving the steering column 6 inches to the right.



Kia Forte

Small car ratings in small overlap front test

Honda Civic 4-door



The 4-door Honda Civic's occupant compartment stayed intact during the crash so survival space for the dummy was well-maintained. A strong safety cage that resists crash forces is key to a good rating for structure.

		Overall	Structure	Restraints & kinematics	Dummy injury measures			
					Head & neck	Chest	Hip & thigh	Lower leg & foot
	Honda Civic 4-door	G	G	G	G	G	G	A
	Honda Civic 2-door	G	G	G	G	G	G	M
	Dodge Dart	A	A	M	G	G	G	G
	Ford Focus	A	M	A	G	G	G	G
	Hyundai Elantra	A	M	A	G	G	G	G
	Scion tC 2014	A	M	A	G	G	G	A
	Chevrolet Sonic	M	A	M	G	G	G	M
	Volkswagen Beetle	M	A	P	G	G	G	G
	Chevrolet Cruze	M	P	M	G	G	G	G
	Nissan Sentra	P	P	M	G	G	A	M
	Kia Soul	P	P	P	G	G	G	M
	Kia Forte 2014	P	P	P	A	G	P	M

Good **G** Acceptable **A** Marginal **M** Poor **P**

crash energy. That increases the risk of severe damage to or collapse of the occupant compartment structure. Also, vehicles tend to rotate and slide sideways during this type of collision, and that can move the driver's head outboard, away from the protection of the front airbag. If the dummy misses the airbag or slides off of it, the head and chest are unprotected.

That's what happened when the Volkswagen Beetle was put to the test. During impact, the steering column moved nearly 5 inches to the right as the dummy's upper body moved forward and to the left. The

earns a marginal rating overall, helped by an acceptable rating for structure and good dummy injury measures.

A similar problem with safety belts and airbags was seen with the Kia Forte, the worst performer for both restraints and structure of all of the small cars evaluated. Too much belt slack and a side curtain airbag that deployed but didn't provide enough forward coverage allowed the dummy's head to hit the windshield pillar and instrument panel.

In contrast, both the 2-door and 4-door versions of the Civic earn good ratings for restraints and kinematics and structure.

marginal rating for restraints and kinematics and acceptable for structure.

Good side curtain airbag coverage in the Elantra helped the car earn an acceptable rating, even though the belt allowed the dummy to move forward 11 inches. Among vehicles in which the side curtain airbag deployed, only those in the Elantra, Civics and Scion tC offered sufficient forward coverage.

"Toyota changed the airbag algorithm in the 2014 model tC so the curtain airbag would deploy in a small overlap crash. That helped boost the Scion's rating. Without the change, the tC would have had a marginal rating for restraints and kinematics," Zuby says.

The Institute didn't test the Toyota Corolla because the automaker plans to release a redesigned 2014 model in August.

The Dart was tested twice because of an on-board camera malfunction in the first test. Engineers use footage from cameras to assess how dummies move during crash tests. In the Dart retest, the driver door opened when the hinges tore away from the door frame. In the initial test, the hinges were severely damaged and the lower one tore away, but the door stayed shut. In both tests, the Dart's safety belts and front and side curtain airbags effectively protected the dummy's head and upper body, and sensors in the dummy showed little risk of injury to a person in a similar real-world crash. The Institute averaged results of both tests and downgraded the Dart's restraints and kinematics rating to marginal because doors shouldn't open in a crash. Without the issue, the Dart would have earned a good rating for restraints and kinematics. It earns an acceptable rating for structure.

Having six small cars qualify for the Institute's highest safety award broadens the choices for consumers looking to buy a small car. The latest results highlight how some automakers are designing models to perform well in the demanding small overlap test. At the same time, other automakers have more work to do.

"Manufacturers need to focus on the whole package," Zuby says. "That means a strong occupant compartment that resists the kinds of intrusion we see in a frontal crash like this, safety belts that prevent a driver from pitching too far forward and side curtain airbags to cushion a head at risk of hitting the dashboard or window frame." ■



The 2013 Honda Civic, in both the 2-door and 4-door versions, earns a good rating in the small overlap front test and qualifies for the *TOP SAFETY PICK+* accolade.

To earn the top rating of good in the small overlap test, manufacturers need to focus on overall crash protection. That means a strong safety cage that resists intrusion, safety belts that prevent a driver from pitching too far forward and side curtain airbags that provide enough forward coverage to cushion a head at risk of hitting the dashboard or window frame.

rotation meant that the dummy's head barely contacted the front airbag. At the same time, the safety belt spooled out too much, allowing the dummy to move forward 13 inches and hit its head on the dashboard. The side airbag didn't deploy. Instead of a curtain airbag, the Beetle has a seat-mounted combination head-torso side airbag that isn't designed to protect the head in this type of crash. All of these issues add up to a poor restraints and kinematics score for the Beetle. The Volkswagen

Dummy movement during the tests was well-controlled, and both cars had only minimal intrusion into the occupant compartment, so survival space for the dummy was well-maintained.

Timing the side curtain airbag to deploy to provide optimal head protection in the crash also is key. In the Chevrolet Sonic test, the airbag deployed after the dummy had already moved toward the open driver window, leaving its head on the wrong side of the curtain airbag. The Sonic earns a

Small overlap front crashes aren't just a U.S. issue, German study finds

IIHS crash test addresses real-world occupant injury patterns seen in crashes on Germany's roads

Small overlap crashes account for a quarter of frontal crashes of all severities in Germany, a new study of insurance claims indicates. The finding is in line with IIHS research and adds more evidence that the Institute's newest vehicle ratings program addresses problems seen in real-world collisions.

Small overlap front crashes involve an overlap of as much as 25 percent of a vehicle's front end. The Institute's 40 mph small overlap front test is designed to replicate what happens when the front corner of a vehicle collides with another vehicle or an object. Introduced in 2012, the test is especially demanding of safety belt and airbag systems. IIHS is the only organization that currently includes a small overlap test in its crash test program providing consumers with comparative vehicle safety information (see *Status Report*, Aug. 14, 2012, at iihs.org).

In an attempt to quantify the problem in Germany, researchers at the German Insurers Accident Research (UDV) arm of the German Insurance Association analyzed insurance claims data to determine the prevalence of small overlap front crashes in relation to other crash configurations and identify the characteristics of these crashes and the patterns of injuries that occur in them.

Researchers examined claims data for 3,242 crashes involving passenger cars in Germany during 2002-09. All of the crashes in the database involved personal injury claims and vehicle damage costs of 15,000 euros or more (\$19,000). More than half were frontal impacts. Small overlap crashes accounted for about 25 percent of frontal crashes and 15 percent of all crashes.

In a 2009 IIHS study of vehicles with good ratings for frontal crash protection, small overlap crashes accounted for nearly a quarter of the frontal crashes involving serious or fatal injury to front seat occupants (see *Status Report*, March 7, 2009).

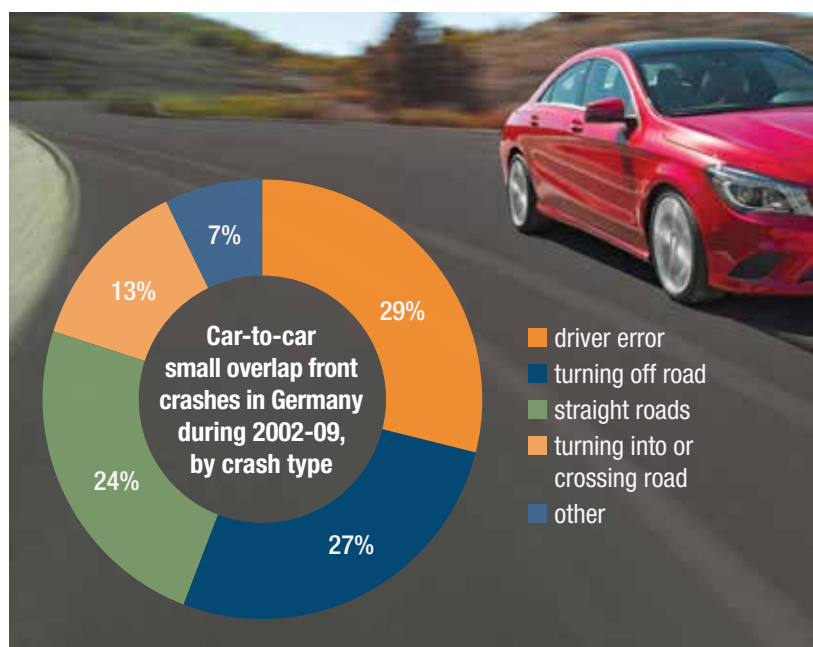
In the German study, nearly two-thirds of car-to-car small overlap front crashes occurred on rural roads, with 37 percent on or near a curve. Looking at circumstances, 40 percent of crashes happened as drivers turned off the road or turned into or crossed a road. Nearly a third of the crashes were classified as "driving accidents" involving driver error. Of these, 74 percent took place near a curve.

"This gives reason to believe that a collision with a small overlap often happens because the party responsible for the [crash] gets into the oncoming lane unintentionally as a result of a driving error or due to inappropriate speed," the authors say. They note that crash avoidance systems might help to prevent some of these crashes.

Looking at injury patterns, small overlap crashes resulted in more lower extremity injuries than other frontal crashes. About 40 percent of all serious injuries (Abbreviated Injury Scale of 3) were to drivers' lower legs and feet. In contrast, only 24 percent of drivers in large overlap crashes had these injuries. What's more, drivers injured in small overlap crashes were nearly twice as likely to be unable to work for three months or longer as drivers in large overlap crashes.

"In the small overlap cases, which were more costly, the high costs involved were demonstrably attributable to complex foot injuries of the drivers involved that take a long time to heal," the authors note.

In the IIHS small overlap front test, dummy injury measures indicate that lower leg and foot injuries would be likely in many new vehicles. One of these is the Mercedes-Benz C-Class. The 2012



C-Class was among the 11 luxury/near-luxury cars IIHS evaluated in its inaugural round of tests. The C-Class earned a poor rating overall, including poor for lower leg and foot protection. Intruding structure caused the dummy's right foot to become wedged beneath the brake pedal. Intrusion into the footwell also was a problem for the Acura TSX, BMW 3 Series, Lexus IS 250/350 and Lexus ES 350. All earned poor ratings for lower leg and foot protection.

Since then, manufacturers have been making design changes to improve protection in small overlap front crashes. Initially, the Institute's new test raised questions among some automakers about its relevance to the types of crashes that happen outside the U.S.

Findings of the UDV study of crashes in Germany confirm that the small overlap crash problem isn't unique to the U.S. The authors conclude that crashes "involving a small overlap are at least as relevant as [crashes] involving a large overlap in the damage claims of insurers" and justify "efforts to implement countermeasures."

For a copy of "Small-overlap frontal impacts involving passenger cars in Germany" by M. Kühn et al. go to www.udv.de/en/publications. ■

Ford F-250 has highest theft rate of any 2010-12 models

Cadillac Escalade drops to 6th on HLDI list after years on top



The Ford F-250 has replaced the Cadillac Escalade as the favorite target of thieves, the Highway Loss Data Institute (HLDI) reports. New antitheft technology on the Escalade, as well as its waning popularity, are two likely reasons the luxury SUV has fallen from first to sixth place in the ranking of vehicles with the highest rates of insurance claims for theft.

“General Motors has put a lot of effort into new antitheft technology, so that may help explain the decline in the Escalade’s theft rate,” says HLDI Vice President Matt Moore. “On the other hand, sales of the Escalade have fallen in recent years, so there may be less of a market for stolen Escalades or Escalade parts.”

Thieves continue to target large pickups and large SUVs at higher rates than other vehicles. No. 1 on this year’s list, the four-wheel-drive F-250 crew cab, has a claim frequency of 7 per 1,000 insured vehicle years, or nearly 6 times the average for all vehicles. An insured vehicle year is one vehicle insured for one year, two for six months, etc.

Theft rates in general are declining, thanks in large part to the spread of ignition immobilizers, which prevent vehicles from being hot-wired and were standard in 89 percent of 2012 models. Fewer pickups than cars or SUVs have the feature as standard, which may help explain the higher theft rates for pickups. However, it doesn’t explain the high theft rate of the F-250, which had a standard immobilizer for 2010-12, the model years covered in this year’s report.

Many pickup claims result from the theft of equipment from the truck bed, and that may be the case with some of

the F-250 claims. HLDI’s data don’t distinguish theft of vehicle contents or components from theft of a whole vehicle.

Each year HLDI analyzes theft losses for vehicles from the three previous model years. This is the first year since 2003 that some version of the Escalade hasn’t topped the list of vehicles with the highest theft claim rates.

This year the Escalade has a claim frequency of 5.5 per 1,000 insured vehicle years. Though still more than 4 ½ times the average, that’s about half the rate for 2007-09 Escalades reported in 2010. Only the regular four-wheel-drive version of the Escalade is included in this report. Other versions didn’t have sufficient exposure or claims. To be included, a vehicle must have at least 20,000 insured vehicle years or 100 claims.

The Escalade always has had a standard ignition immobilizer, but thieves still could tow away the SUV on a flatbed truck. Since 2010, the Escalade has had a steering column lock as well. An improved version of this feature, along with an inclination sensor that sets off an alarm when the vehicle’s angle is changed, was added in the 2012 model year. One indication these new features may be helping is that the average loss payment of each Escalade claim has fallen to \$6,508, suggesting fewer whole-vehicle thefts. In contrast, the average loss payment for 2007-09 Escalades was \$11,934. Other antitheft features, including a wheel-lock system, are available as options on 2012 models.

HLDI’s theft numbers differ from other rankings because they are based on the number of insured vehicles on the road. In contrast, information published by the National Insurance Crime Bureau simply lists the most frequently stolen vehicles. As a result, that list usually reflects the most commonly driven models. ■

This is the first time since 2003 that an Escalade model doesn’t lead the list of vehicles with the highest theft claims.



Ford F-250



The Chevrolet Silverado 1500 crew (top) has the second-highest theft claim rate. The Dodge Journey 4WD has the lowest claim rate for theft.

In France, use of speed cameras across the nation's roads is tied to 10 percent drop in death rate

France's extensive speed camera program has cut crash fatalities in the country, a recent analysis finds.

Researchers in France and Canada compared the number of fatalities per 100,000 registered vehicles in France during a four-year period before the camera program started in November 2003 with the seven years following. The researchers found camera enforcement was associated with a 10 percent decline in the fatality rate.

France began blanketing the nation's road network with speed cameras after then-President Jacques Chirac declared a "fight against road violence," and the program has grown steadily since then (see *Status Report*, Jan. 31, 2008, at iih.org). By 2010, more than 2,750 cameras were operating. Two-thirds of the cameras are in fixed locations and are accompanied by warning signs. The rest are mobile.

Speed cameras have been catching on in the U.S. as well, though they aren't as widespread as red light cameras. A total of 129 communities operate speed camera programs in the U.S., compared with 521 that have red light cameras. Although automated enforcement is often considered controversial, thanks to a vocal minority who oppose it, surveys show support for the programs. A recent IIHS survey of Washington, D.C., residents found that three-quarters support speed cameras, and nearly 9 in 10 support red light cameras (see *Status Report*, April 25, 2013).

The study of France's speed camera program found that the July 2002 announcement of the initiative, which was widely covered in the media and included not only the introduction of cameras but also increased penalties for traffic violations and the creation of new traffic offenses, was associated with a 12 percent drop in the fatality rate. When the cameras became operational, there was an additional reduction of 10 percent, and that effect persisted over time.

The researchers compared different time periods to be sure the reduction wasn't caused by a recession that started around October 2008 and found the estimates didn't change.

The rate of nonfatal injuries also declined after the announcement and in the first month of the program, but, unlike the effect on fatalities, the effect on injuries diminished over time.

"An assessment of the safety effects of the French speed camera program" by L. Carnis and E. Blais appears in the March 2013 issue of *Accident Analysis and Prevention*. ■

Insurance theft claims, 2010-12 passenger vehicles

	Vehicle size/type	Claim frequency	Avg. loss payment per claim	Overall theft losses
Highest claim rates				
Ford F-250 crew 4WD	very large pickup	7.0	\$7,060	\$50
Chevrolet Silverado 1500 crew	large pickup	6.7	\$5,463	\$37
Chevrolet Avalanche 1500	very large SUV	6.1	\$6,163	\$38
GMC Sierra 1500 crew	large pickup	6.0	\$6,366	\$38
Ford F-350 crew 4WD	very large pickup	5.6	\$7,517	\$42
Cadillac Escalade 4WD	large luxury SUV	5.5	\$6,508	\$36
Chevrolet Suburban 1500	very large SUV	5.4	\$4,468	\$24
GMC Sierra 1500 extended cab	large pickup	4.7	\$5,908	\$28
GMC Yukon	large SUV	4.5	\$6,276	\$28
Chevrolet Tahoe	large SUV	4.4	\$5,367	\$23
Lowest claim rates				
Dodge Journey 4WD	midsize SUV	0.4	\$5,016	\$2
Volkswagen Tiguan 4WD	small SUV	0.4	\$10,352	\$4
Audi A4 4-door	midsize luxury car	0.4	\$13,803	\$5
Acura RDX	midsize luxury SUV	0.4	\$8,701	\$3
Toyota Matrix	small station wagon	0.4	\$7,782	\$3
Lexus HS 250 hybrid 4-door	midsize luxury car	0.4	\$2,226	\$1
Honda CR-V	small SUV	0.4	\$4,630	\$2
Hyundai Tucson 4WD	small SUV	0.4	\$4,134	\$2
Toyota Sienna 4WD	very large minivan	0.5	\$13,038	\$6
Jeep Compass 4WD	small SUV	0.5	\$5,527	\$3
Average all passenger vehicles		1.2	\$6,532	\$8

Claim frequency is per 1,000 insured vehicle years; overall losses are average payments per insured vehicle year.

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The **Highway Loss Data Institute** shares and supports this mission through scientific studies of insurance data representing the human and economic losses resulting from the ownership and operation of different types of vehicles and by publishing insurance loss results by vehicle make and model.

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