New crash test spotlights lagging protection for rear passengers

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The Insurance Institute for Highway Safety is updating its longest-running crash test, the moderate overlap front evaluation, to address a growing gap in the protection provided for front and rear occupants. In the first tests, only two out of 15 small SUVs, the Ford Escape and Volvo XC40, protect the rear occupant well enough to earn a good rating.

The Toyota RAV4 earns an acceptable rating, and the Audi Q3, Nissan Rogue and Subaru Forester are rated marginal. Another nine vehicles — the Buick Encore, Chevrolet Equinox, Honda CR-V, Honda HR-V, Hyundai Tucson, Jeep Compass, Jeep Renegade, Mazda CX-5 and Mitsubishi Eclipse Cross — are rated poor.

“The original moderate overlap test was our first evaluation and the lynchpin of the Institute’s crash testing program,” said IIHS President David Harkey. “Thanks to automakers’ improvements, drivers in most vehicles are nearly 50 percent less likely to be killed in a frontal crash today than they were 25 years ago. Our updated test is a challenge to manufacturers to bring those same benefits to the back seat. The stellar performance of the Escape and XC40 shows it’s possible.”

All 15 vehicles earn good ratings in the original evaluation, demonstrating robust structures and effective restraints that protect the driver’s head from contacting the hard surfaces of the interior and minimize the risk of other types of injuries. However, the additional measurements provided by the new test show that most of them don’t provide adequate protection for the rear passenger’s head and neck — the most vulnerable areas of the body.

A step forward for the back

In the original moderate overlap frontal test, a vehicle travels at 40 mph toward a barrier with a deformable face made of aluminum honeycomb. A Hybrid III dummy representing an average-size man is positioned in the driver seat. Forty percent of the total width of the vehicle strikes the barrier on the driver side. The forces in the test are similar to those that would result from a frontal offset crash between two vehicles of the same weight, each going just under 40 mph.

When the original test was launched, in 1995, most vehicles were rated poor or marginal. Today, all vehicles earn good ratings, but there’s further work to be done. A recent IIHS study of real-world crashes showed that in many cases, back-seat passengers were injured more severely than front-seat occupants.

Not long ago, passengers seated in the rear were substantially less likely to be killed in a frontal offset crash than the driver or front-seat passenger because the biggest factor in survival was the crumpling of the front of the occupant compartment. Now, though, there is barely any deformation of the occupant compartment in the moderate overlap test. In addition, automakers have added airbags and advanced seat belts in the front seats but not often in the rear. As a result, in vehicles from model year 2007 onward, the risk of a fatal injury is 46 percent higher for belted occupants in the rear seat than in the front.

To push automakers to address that widening gap, the new test incorporates a second Hybrid III dummy representing a small woman or 12-year-old child positioned in the second row behind the driver and utilizes new metrics that focus on the injuries most frequently seen in rear-seat occupants.

“We’re excited to launch the first frontal crash test in the U.S. to include a rear-occupant dummy,” said IIHS Senior Research Engineer Marcy Edwards, who led the development of the new evaluation. “This is a fantastic opportunity to rapidly deliver big safety benefits by adapting technologies that we already know to be effective.”

For example, in the front seat, crash tensioners tighten the seat belts the instant a crash begins so that the occupant's body begins to slow with the vehicle. Then, as the tightened belt stops the occupant from flying forward, force limiters allow some of the webbing to spool out to reduce the risk of chest injuries. Rear-seat occupants would also benefit from these technologies. Features like rear seat airbags and seat belts that themselves inflate to mitigate the effects of crash forces could help too. But less than half of new vehicles have advanced restraint systems in the rear seat.

The test speed, offset and barrier used in the new test remain the same as in the original one. Vehicles still receive ratings of good, acceptable, marginal or poor, but they have to meet several new requirements along with the earlier ones.

To earn a good rating, measurements recorded by sensors in the second-row dummy must not exceed limits indicating an excessive risk of injury to the head, neck, chest, abdomen or thigh. Video footage and greasepaint applied to the dummy's head must confirm that the restraints prevented the head from hitting the vehicle interior or coming too close to the front seatback and also prevented the dummy's body from "submarining," or sliding forward beneath the lap belt, which causes abdominal injuries. A pressure sensor that monitors the position of the shoulder belt on the torso of the dummy is being used for the first time to help gauge the risk of chest injuries.

"In real-world crashes, chest injuries are the most common serious rear-seat injuries for adults, so that's a key focus," said Research Engineer Sushant Jagtap, who assisted in the development of the new test.

How they fared

As expected, the occupant compartments of all 15 small SUVs held up well, and measurements taken from the driver dummies indicated a minimal risk of injuries in all but the Equinox, which showed a slightly elevated risk of injury to the driver's right foot.

The good-rated Escape and XC40 also showed minimal risk of any of those injuries for the second-row passenger. There was also no excessive force on the dummy's chest or misalignment of the safety belt shoulder strap and no submarining under the lap belt or malfunctioning of the side curtain airbag. However, in the Escape, the rear dummy's head came closer to the front seatback than is desirable. The rating for the Escape applies to vehicles built after May 2022, when Ford made adjustments to the rear seat belts.

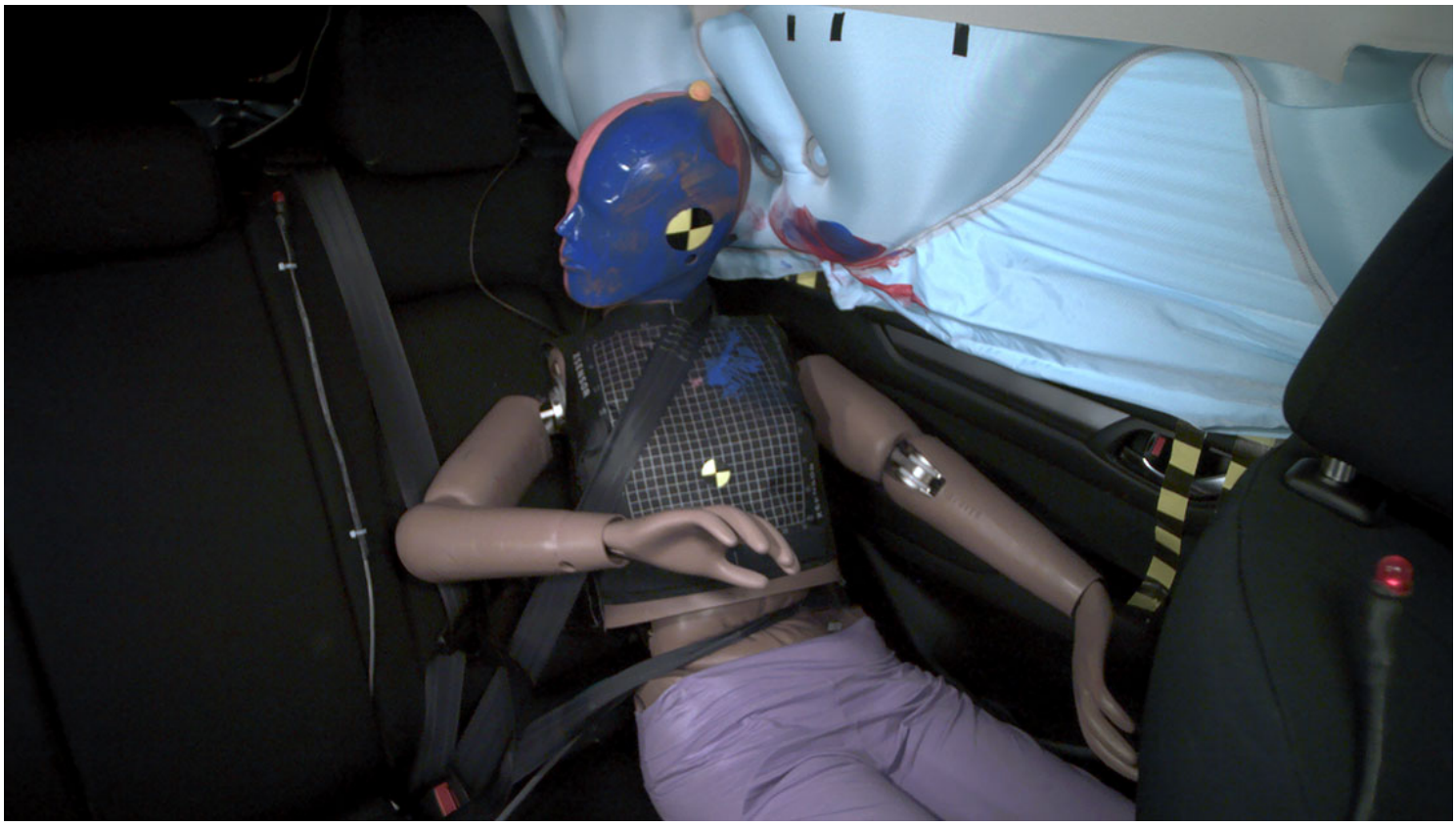
Measurements taken from the head, neck, chest and lower extremities of the rear dummy also showed minimal risks of injuries to those areas in the acceptable-rated RAV4. However, the second-row dummy's lap belt moved from the ideal position on the pelvis into the abdomen, increasing the risk of abdominal injuries. The rear passenger dummy's head also dipped beneath the side curtain airbag during the crash and popped up between the airbag and window on rebound.

Among the three marginal-rated vehicles, injury measures taken from the second-row dummy indicated elevated risks of head and neck injuries in the Q3 and Rogue and a high risk of chest injuries in the Forester. The rear passenger dummy's lap belt slipped from the pelvis onto the abdomen in the Q3 and Rogue, and in all three vehicles the rear dummy's head came too close to the front seatback during the crash.

In all nine poor-rated vehicles, injury measurements indicated high risks of head, neck and chest injuries for the rear passenger, and the seat belt exerted excessive forces on the chest of the second-row dummy. In the CR-V and CX-5, the position of the rear dummy's shoulder belt was also very high, which can make the restraint system less effective. In the Eclipse Cross, Encore and Tucson, the rear passenger dummy came close to making contact with the front seatback, while in the Encore, Renegade and Tucson, the rear passenger dummy's head ended up between the side curtain airbag and the window following the initial impact. In the Renegade, this allowed the rear dummy's head to make hard contact with the C-pillar that connects the vehicle body with the roof behind the rear window.

In the CX-5 and HR-V, submarining by the rear passenger dummy caused the lap belt to slip from the pelvis to the abdomen, increasing the chances of abdominal injuries.

Buick Encore: The rear passenger dummy's head came close to contacting the front seatback, which increases the risk of head injuries.



Mazda CX-5: The rear passenger dummy's lap belt moved from the ideal position on the pelvis onto the abdomen, increasing the risk of abdominal injuries.

Jeep Renegade: During rebound, the rear passenger dummy's head moved outside of the side curtain airbag and hit the C-pillar hard. The head protection is inadequate and puts the head at risk of possible contact with outside objects.

Ratings in updated moderate overlap front test: small SUVs

			Driver injury measures					Rear passenger injury measures			
	Overall rating	Structure & safety cage	Head & neck injury	Chest	Knee & thigh	Leg & foot	Driver restraints & kinematics	Head & neck	Chest	Thigh	Rear passenger restraints & kinematics
2022-23 Ford Escape *built after May 2022*	G	G	G	G	G	G	G	G	G	G	A
2021-23 Volvo XC40	G	G	G	G	G	G	G	G	G	G	G
2021-23 Toyota RAV4	A	G	G	G	G	G	G	G	G	G	P
2021-23 Audi Q3	M	G	G	G	G	G	G	A	G	G	P
2021-23 Nissan Rogue	M	G	G	G	G	G	G	A	G	G	P
2021-23 Subaru Forester	M	G	G	G	G	G	G	G	M	G	A
2021-22 Buick Encore	P	G	G	G	G	G	G	M	P	G	M
2021-23 Chevrolet Equinox	P	G	G	G	G	A	G	P	P	G	G
2021-22 Honda CR-V	P	G	G	G	G	G	G	M	P	G	G

			Driver injury measures					Rear passenger injury measures			
	Overall rating	Structure & safety cage	Head & neck injury	Chest	Knee & thigh	Leg & foot	Driver restraints & kinematics	Head & neck	Chest	Thigh	Rear passenger restraints & kinematics
2021-22 Honda HR-V	P	G	G	G	G	G	G	P	M	G	P
2021 Hyundai Tucson	P	G	G	G	G	G	G	P	P	G	A
2021 Jeep Compass	P	G	G	G	G	G	G	P	P	G	G
2021-23 Jeep Renegade	P	G	G	G	G	G	G	P	P	G	A
2021-22 Mazda CX-5	P	G	G	G	G	G	G	P	P	G	P
2022-23 Mitsubishi Eclipse Cross	P	G	G	G	G	G	G	P	P	G	M

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