

INSURANCE INSTITUTE FOR HIGHWAY SAFETY

NEWS RELEASE

April 5, 2007

REAR CRASH PROTECTION IN CARS: SEAT/HEAD RESTRAINTS IN TWO OF EVERY THREE MODELS ARE MARGINAL OR POOR

ARLINGTON, VA — Seat/head restraint designs in 22 current car models are rated good for rear crash protection, but those in 53 other cars are rated marginal or poor. The latest evaluations of occupant protection in rear-end collisions by the Insurance Institute for Highway Safety found that the seat/head restraints in more than 60 percent of car models fall short of current state-of-the-art protection from neck injury or whiplash.

The ratings of good, acceptable, marginal, or poor are based on geometric measurements of head restraints and simulated crashes that together assess how well people of different sizes would be protected in a typical rear-end collision.

Among the winners are seat designs in all Volvos; Audi A4, S4 and A6; Ford Five Hundred/Mercury Montego; Nissan Sentra and Versa; Saab 9-3; and Subaru Impreza and Legacy/Outback. Seat/head restraints in 12 other car models are rated acceptable. These results show some improvement since the Institute began rear impact tests of seat/head restraints in 2004. Seats in only 8 car models earned good ratings in 2004.

"Even though we have more good performers, it's disappointing that so many designs are still rated marginal or poor," says Institute president Adrian Lund. "Neck injuries are common in crashes, and it's not difficult or expensive to design more protective seat/head restraints."

Rear-end collisions are frequent, and neck injuries are the most common injuries reported in automobile crashes. They account for 2 million insurance claims each year, costing at least \$8.5 billion. Such injuries aren't life threatening, but they can be painful and debilitating.

"We're simulating what happens when a vehicle rear-ends another one in commuter traffic or at a stop light," Lund says. "People think of head restraints as head rests, but they're not. They're important safety features. You're more likely to need the protection of a good head restraint than the other safety devices in your vehicle because rear-end crashes are so common."

— MORE —

Good seat/head restraint design keeps head and torso moving together: When a vehicle is struck in the rear and driven forward, the vehicle seats accelerate occupants' torsos forward. Unsupported, an occupant's head will lag behind the forward movement of the torso. This differential motion causes the neck to bend and stretch. The higher the torso acceleration, the more sudden the motion, the higher the forces on the neck, and the more likely a neck injury is to occur. "The key to reducing whiplash injury risk is to keep the head and torso moving together," Lund explains. "To accomplish this, the geometry of a head restraint has to be adequate, and so do the stiffness characteristics of the vehicle seat. Then the seat and head restraint have to work in concert to support an occupant's neck and head, accelerating them with the torso as the vehicle is driven forward."

A head restraint should extend at least as high as the center of gravity of the head of the tallest expected occupant. A restraint also should be positioned close to the back of an occupant's head so it can contact the head and support it early in a rear-end crash. If a restraint isn't positioned behind the head, it cannot support the head, but good restraint geometry by itself isn't sufficient. A seat also has to be designed so its head restraint doesn't move backward in a rear impact because this would prevent the restraint from catching the head. At the same time, a vehicle seat cannot be too stiff. It has to "give" so an occupant will sink into it, moving the head closer to the restraint.

Eight designs earn better ratings: More manufacturers are paying attention to safer seat design. This is reflected in better ratings for some seats compared with ratings the Institute published in 2004. Seat/head restraints in the Audi A4 and S4, Honda Civic, Hyundai Sonata, Kia Optima, and Nissan Sentra improved from poor to good. Seat/head restraints in the Mercedes E class and Subaru Legacy/Outback improved from acceptable to good. Improving to acceptable are seat/head restraints in the BMW 3 series, Ford Focus, Hyundai Elantra, Lexus IS, and Mercedes C class. Many of the models with improved ratings have "active" designs that automatically move a head restraint up and toward the back of the head in a crash. Mercedes models use a spring-loaded system that activates when sensors detect a crash. Other cars have mechanisms in the seatbacks that push the head restraint up when an occupant's torso sinks into the seat during a crash. While many automakers are making improvements, a few are going in the wrong direction. Seat/head restraints in the Chrysler 300, Kia Amanti, and Nissan Altima earned marginal ratings this time compared with acceptable ratings for the earlier designs tested in 2004.

Geometry is improving: The Institute doesn't test seats with head restraints that are rated marginal or poor for geometry. These seats automatically earn the lowest rating of poor because their head restraints cannot be positioned to protect many taller people. In this round of evaluations, the worst ratings based on geometry belong to seats in the Cadillac DTS, Pontiac Grand Prix, Suzuki Forenza and Reno, plus some seats in the BMW 5 series, Buick Lacrosse, and Mitsubishi Galant.

"Still it's encouraging that the seat/head restraint combinations in only 7 of the models we evaluated didn't make it to the dynamic test because of marginal geometry," Lund says. "When we began evaluating the geometry of head restraints in 1995, most earned the lowest rating of poor. Back then, head restraints in most cars weren't tall enough or close enough to the head to begin to provide adequate protection for people as tall as an average-size man."

In response to the Institute's 1995 evaluations, manufacturers began to make changes. They designed head restraints taller and closer so they're more likely to be in position to catch people's heads in rear-end collisions. Further improvements are being driven by the federal government. A new regulation will require head restraints to extend higher and fit closer to the backs of people's heads by the 2009 model year. Automakers also have been spurred to better designs by the Institute's *TOP SAFETY PICK* award. Winning vehicles have to earn good ratings in all three Institute crash tests — front, side, and rear.

"Audi and Subaru redesigned their seats and head restraints specifically to earn *TOP SAFETY PICK* in 2007," Lund points out. "Other automakers are working on this aspect of crashworthiness specifically to earn the award."

International effort by insurers: Recognizing improvements in head restraint geometry and the need to move beyond ratings based solely on geometry, Institute researchers joined with other whiplash injury prevention experts in late 2000 to organize the International Insurance Whiplash Prevention Group (IIWPG). IIWPG conducted extensive research and testing to develop the procedures for the dynamic tests and evaluation criteria used by member research groups, including the Institute, to rate the performance of seat/head restraint combinations in vehicles sold in a number of world markets. Ratings also are being released by IIWPG members in Canada, the United Kingdom, Europe, and Australia.

Sled test simulates rear-end collision: Seat/head restraint ratings are based on a two-step evaluation. In the first step restraint geometry is rated using measurements of height and distance from the back of the head of a mannequin that represents an average-size man. Seats with good or acceptable geometric ratings are subjected to a dynamic test conducted on a crash simulation sled. The sled test replicates the forces in a stationary vehicle that's rear-ended by another vehicle of the same weight going 20 mph, which accelerates the struck vehicle to 10 mph. The sled is a movable steel platform that runs on fixed rails and can be programmed to re-create the accelerations that occur inside vehicles during real-world crashes.

A dummy specially designed to assess rear-end crash protection, BioRID, is used to measure the forces on the neck during the simulated crashes. Researchers also measure how hard the seatback pushes on the dummy's back and how quickly the head restraint supports the head.

The Institute's dynamic ratings of good, acceptable, marginal, or poor are derived from two seat design parameters (peak acceleration of the dummy's torso and time from impact initiation to head restraint contact with the dummy's head) plus neck tension and shear forces recorded on BioRID during the test. The sooner a restraint contacts the dummy's head and the lower the acceleration of the torso and the forces on BioRID's neck, the better the dynamic rating. A seat/head restraint's dynamic evaluation is combined with its geometric evaluation to produce an overall rating.

**End 4-page news release: ratings of seat/head restraints in cars
2 attachments: model-by-model ratings of seat/head restraints**

**VNR 4/5/2007 at 10:30-11 am EDT (C) AMC 3/Trans 3 (dl3760H)
repeat at 2-2:30 pm EDT (C) AMC 3/Trans 3 (dl3760H); dedicated**

For more information go to www.iihs.org

ATTACHMENT 1: P. 1 of 4
DYNAMICALLY TESTED SEAT/HEAD RESTRAINTS

PASSENGER CARS		OVERALL RATING	DYNAMIC RATING	GEOMETRY OF SEAT/HEAD RESTRAINT
Make/model	Seat type tested			
ACURA RL 2005-07 models	ALL SEATS	M	M	A
ACURA TL 2004-07 models	ALL SEATS	M	M	G
ACURA TSX 2004-07 models	ALL SEATS	P	P	G
AUDI A3 2006-07 models	MOST POPULAR SEAT OPTION (ACTIVE HEAD RESTRAINTS)	A	A	G
AUDI A4 2007 models (mfg. after July 2006)	MOST POPULAR SEAT OPTION	G	G	G
AUDI A6 2007 models (mfg. after Nov. 2006)	MOST POPULAR SEAT OPTION	G	G	G
AUDI S4 2007 models	MOST POPULAR SEAT OPTION	G	G	G
BMW 3 SERIES 2006-07 models (mfg. after Feb. 2006)	MOST POPULAR SEAT OPTION	A	A	G
BMW 5 SERIES 2004-07 models	COMFORT SEATS (ACTIVE HEAD RESTRAINTS)	A	A	G
BMW 5 SERIES 2004-07 models	BASE SEATS	P	P	A
BUICK LACROSSE 2005-07 models	CLOTH SEATS WITHOUT ADJUSTABLE LUMBAR	P	P	A
BUICK LUCERNE 2006-07 models	MOST POPULAR SEAT OPTION	P	P	A
CADILLAC CTS 2003-07 models	SEATS WITHOUT ADJUSTABLE LUMBAR	P	P	A
CADILLAC STS 2005-07 models	SEATS WITHOUT ADJUSTABLE LUMBAR	P	P	A
CHEVROLET AVEO 2007 models	MOST POPULAR SEAT OPTION	P	P	G
CHEVROLET COBALT 2005-07 models	ALL SEATS	G	G	G
CHEVROLET IMPALA 2006-07 models	MOST POPULAR SEAT OPTION	M	M	A
CHEVROLET MALIBU 2004-07 models	ALL SEATS	A	A	G

G GOOD
A ACCEPTABLE
M MARGINAL
P POOR

continues on next page...

For each seat/head restraint, REAR-END CRASH PROTECTION is an assessment of occupant protection against neck injury in rear impacts at low to moderate speeds. Such injuries usually aren't serious, but they're frequent. OVERALL RATINGS are based on a two-step evaluation. In the first step head restraint geometry (distance behind and below the head of a seated average-size man) is rated good, acceptable, marginal, or poor. Seats with good or acceptable restraint geometry then are subjected to a dynamic test simulating the forces in a stationary vehicle that's rear-ended by another vehicle of the same weight going 20 mph. Seat/head restraints with marginal or poor geometry aren't tested dynamically because they cannot protect taller people in rear-end crashes. These seats are rated poor overall. In the dynamic test, measurements are recorded on a dummy (BioRID) representing an average-size man. BioRID is designed specifically for rear-end testing at low to moderate speeds. The DYNAMIC RATINGS are derived from two seat design parameters (peak acceleration of the dummy torso and time from impact initiation to head restraint contact with the dummy head) plus tension and shear forces recorded on BioRID's neck during the test. Overall ratings are based on both geometric measurements and dynamic results.

ATTACHMENT 1: P. 2 of 4
DYNAMICALLY TESTED SEAT/HEAD RESTRAINTS

PASSENGER CARS		OVERALL RATING	DYNAMIC RATING	GEOMETRY OF SEAT/HEAD RESTRAINT
Make/model	Seat type tested			
CHRYSLER 300 DODGE CHARGER DODGE MAGNUM 2006-07 models	MOST POPULAR SEAT OPTION	M	M	G
CHRYSLER SEBRING 2007 models	MOST POPULAR SEAT OPTION	A	A	G
DODGE CALIBER 2007 models	MOST POPULAR SEAT OPTION	M	M	G
FORD CROWN VICTORIA 2003-07 models	SEATS WITH ADJUSTABLE LUMBAR	M	M	G
FORD FIVE HUNDRED MERCURY MONTEGO 2005-07 models	MOST POPULAR SEAT OPTION	G	G	G
FORD FOCUS 2006-07 models	MOST POPULAR SEAT OPTION	A	A	G
FORD FUSION LINCOLN ZEPHYR/MKZ MERCURY MILAN 2006-07 models	MOST POPULAR SEAT OPTION	M	M	A
HONDA ACCORD 2003-07 models	EX MODELS STANDARD SEATS	P	P	G
HONDA ACCORD 2003-07 models	LX MODELS STANDARD SEATS	P	P	A
HONDA CIVIC 2DR (except Si) 2006-07 models	ALL SEATS (ACTIVE HEAD RESTRAINTS)	G	G	G
HONDA CIVIC 4DR/HYBRID (except Si) 2006-07 models	ALL SEATS (ACTIVE HEAD RESTRAINTS)	G	G	G
HONDA FIT 2007 models	MOST POPULAR SEAT OPTION	P	P	A
HYUNDAI ACCENT 2006-07 models	MOST POPULAR SEAT OPTION	P	P	G
HYUNDAI AZERA 2006-07 models	MOST POPULAR SEAT OPTION (ACTIVE HEAD RESTRAINTS)	A	A	G
HYUNDAI ELANTRA 2007 models	MOST POPULAR SEAT OPTION (ACTIVE HEAD RESTRAINTS)	A	A	G
HYUNDAI SONATA 2006-07 models	MOST POPULAR SEAT OPTION (ACTIVE HEAD RESTRAINTS)	G	G	G
INFINITI G35 2007 models	MOST POPULAR SEAT OPTION (ACTIVE HEAD RESTRAINTS)	M	M	G
INFINITI M35 2006-07 models	MOST POPULAR SEAT OPTION (ACTIVE HEAD RESTRAINTS)	P	P	A
JAGUAR S-TYPE 2005-07 models	ALL SEATS (ACTIVE HEAD RESTRAINTS)	G	G	G
JAGUAR X-TYPE 2004-07 models	ALL SEATS	P	P	G

G GOOD
A ACCEPTABLE
M MARGINAL
P POOR

continues on next page...

ATTACHMENT 1: P. 3 of 4
DYNAMICALLY TESTED SEAT/HEAD RESTRAINTS

PASSENGER CARS		OVERALL RATING	DYNAMIC RATING	GEOMETRY OF SEAT/HEAD RESTRAINT
Make/model	Seat type tested			
KIA AMANTI 2007 models	MOST POPULAR SEAT OPTION (ACTIVE HEAD RESTRAINTS)	M	M	G
KIA OPTIMA 2006-07 models (mfg. after Sept. 2005)	MOST POPULAR SEAT OPTION (ACTIVE HEAD RESTRAINTS)	G	G	G
KIA RIO 2006-07 models	MOST POPULAR SEAT OPTION	P	P	G
KIA SPECTRA 2005-07 models	MOST POPULAR SEAT OPTION (ACTIVE HEAD RESTRAINTS)	A	A	G
LEXUS ES 350 2007 models	MOST POPULAR SEAT OPTION	M	M	G
LEXUS GS 300/350 2006-07 models	MOST POPULAR SEAT OPTION	M	M	A
LEXUS IS 250/350 2006-07 models	MOST POPULAR SEAT OPTION	A	A	G
LEXUS LS 460 2007 models	MOST POPULAR SEAT OPTION	M	M	G
LINCOLN TOWN CAR 2003-07 models	ALL SEATS	M	M	A
MAZDA 3 2004-07 models	BASE SEATS	M	M	G
MAZDA 3 2004-07 models	SEATS WITH ADJUSTABLE LUMBAR	M	M	A
MAZDA 6 2006-07 models	MOST POPULAR SEAT OPTION	M	M	G
MERCEDES C CLASS 2006-07 models	MOST POPULAR SEAT OPTION (ACTIVE HEAD RESTRAINTS)	A	A	G
MERCEDES E CLASS 2006-07 models	ALL SEATS (ACTIVE HEAD RESTRAINTS)	G	G	G
MERCURY GRAND MARQUIS 2003-07 models	ALL SEATS	M	M	A
MITSUBISHI GALANT 2004-07 models	CLOTH SEATS	P	P	A
NISSAN ALTIMA 2007 models	MOST POPULAR SEAT OPTION (ACTIVE HEAD RESTRAINTS)	M	M	G
NISSAN MAXIMA 2007 models	MOST POPULAR SEAT OPTION (ACTIVE HEAD RESTRAINTS)	M	M	G
NISSAN SENTRA 2007 models	MOST POPULAR SEAT OPTION (ACTIVE HEAD RESTRAINTS)	G	G	G
NISSAN VERSA 2007 models	MOST POPULAR SEAT OPTION (ACTIVE HEAD RESTRAINTS)	G	G	G
PONTIAC G6 2005-07 models	MOST POPULAR SEAT OPTION	M	M	G
SAAB 9-3 2005-07 models	ALL SEATS (ACTIVE HEAD RESTRAINTS)	G	G	G

G GOOD
A ACCEPTABLE
M MARGINAL
P POOR

continues on next page...

ATTACHMENT 1: P. 4 of 4
DYNAMICALLY TESTED SEAT/HEAD RESTRAINTS

PASSENGER CARS		OVERALL RATING	DYNAMIC RATING	GEOMETRY OF SEAT/HEAD RESTRAINT
Make/model	Seat type tested			
SAAB 9-5 2005-07 models	ALL SEATS (ACTIVE HEAD RESTRAINTS)	A	A	G
SATURN AURA 2007 models	MOST POPULAR SEAT OPTION	M	M	A
SATURN ION 2005-07 models	ALL SEATS	M	M	A
SUBARU IMPREZA 2005-07 models (mfg. after Sept. 2004)	ALL SEATS (ACTIVE HEAD RESTRAINTS)	G	G	G
SUBARU IMPREZA WRX (except TR models) 2004-07 models	ALL SEATS	M	M	A
SUBARU LEGACY SUBARU OUTBACK 2006-07 models	ALL SEATS (ACTIVE HEAD RESTRAINTS)	G	G	G
SUZUKI AERIO 2002-07 models	ALL SEATS	M	M	G
SUZUKI SX4 2007 models	MOST POPULAR SEAT OPTION	M	M	G
TOYOTA AVALON 2005-07 models	ALL SEATS	P	P	G
TOYOTA CAMRY 2007 models	MOST POPULAR SEAT OPTION	M	M	G
TOYOTA COROLLA 2005-07 models	ALL SEATS	P	P	A
TOYOTA PRIUS 2004-07 models	MOST POPULAR SEAT OPTION	M	M	G
TOYOTA YARIS 2007 models	MOST POPULAR SEAT OPTION	M	M	G
VOLKSWAGEN JETTA VOLKSWAGEN RABBIT 2007 models	MOST POPULAR SEAT OPTION	M	M	G
VOLKSWAGEN NEW BEETLE 2004-07 models	SEATS WITHOUT ADJUSTABLE LUMBAR (ACTIVE HEAD RESTRAINTS)	A	A	G
VOLKSWAGEN NEW BEETLE 2004-07 models	SEATS WITH ADJUSTABLE LUMBAR (ACTIVE HEAD RESTRAINTS)	G	G	G
VOLKSWAGEN PASSAT 2007 models	MOST POPULAR SEAT OPTION	M	M	G
VOLVO S40 2004-07 models	ALL SEATS	G	G	G
VOLVO S60 2003-07 models	ALL SEATS	G	G	G
VOLVO S80 2007 models	ALL SEATS	G	G	G

G GOOD
A ACCEPTABLE
M MARGINAL
P POOR

**ATTACHMENT 2: P. 1 of 1
SEAT/HEAD RESTRAINTS NOT DYNAMICALLY
TESTED BECAUSE OF INADEQUATE GEOMETRY**

PASSENGER CARS		OVERALL RATING	DYNAMIC RATING	GEOMETRY OF SEAT/HEAD RESTRAINT
Make/model	Seat type tested			
BMW 5 SERIES 2004-07 models	SPORT SEATS	P	not tested (see note)	M
BUICK LACROSSE 2005-07 models	LEATHER SEATS WITH ADJUSTABLE LUMBAR	P	not tested (see note)	M
CADILLAC DTS 2006-07 models	MOST POPULAR SEAT OPTION	P	not tested (see note)	M
MITSUBISHI GALANT 2004-07 models	LEATHER SEATS	P	not tested (see note)	M
PONTIAC GRAND PRIX 2004-07 models	ALL SEATS	P	not tested (see note)	M
SUZUKI FORENZA SUZUKI RENO 2005-07 models	ALL SEATS	P	not tested (see note)	M

G GOOD
A ACCEPTABLE
M MARGINAL
P POOR

end of Attachment 2

Note: Seat/head restraints with marginal or poor geometry aren't tested dynamically because they cannot protect taller people in rear-end crashes. These seats are rated poor overall. Seat/head restraints with good or acceptable geometry are tested dynamically (see Attachment 1).