

STATUS REPORT

INSURANCE INSTITUTE
FOR HIGHWAY SAFETY

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SEAT/HEAD RESTRAINTS NEED
MORE THAN GOOD GEOMETRY TO
EARN GOOD RATINGS; THEY NEED

GOOD DYNAMIC PERFORMANCE

BUT SEATS IN 54 OF 97 CARS ARE RATED POOR; INSURERS JOIN TO RELEASE RATINGS INTERNATIONALLY

Using a new dynamic test and a dummy designed especially for rear impact testing, the Institute has rated 73 seat/head restraint combinations available in 63 car models sold in the U.S. market. The ratings of good, acceptable, marginal, or poor indicate the range of occupant protection from whiplash injury in rear-end crashes at low to moderate speeds.

Starting points for the ratings are the evaluations of head restraint geometry the Institute has been conducting since 1995 (see *Status Report*, Sept. 16, 1995). Now seats with head restraints that have good or acceptable geometry are being tested dynamically to compare their protection against neck injury in rear impacts. These seat/head restraint combinations earn overall ratings based on both geometry and dynamic test results. The Institute isn't testing seats with head restraints rated marginal or poor for geometry because such

seats won't protect taller people. They're rated poor overall, based on geometry.

Only 8 of the 73 seat/head restraints that were dynamically tested earned overall ratings of good. Sixteen are acceptable, and 19 are rated marginal. The other 30 seat/head restraint combinations that were tested are rated poor, as are 24 seats that weren't tested because of inadequate geometry (see ratings on the following pages). The seat/head restraints that were dynamically tested together with those that weren't represent available seats in current car models the Institute has evaluated in its high-speed frontal offset crash test program.

Institute ratings of seats and head restraints in cars sold in the U.S. market are part of an international program that includes ratings of additional seat/head restraints in the Canadian, Australian, and European markets (see p.6).

"Consumers in markets worldwide can use the new ratings to buy cars that provide better protection in rear-end crashes," says Adrian Lund, the Institute's chief operating officer.

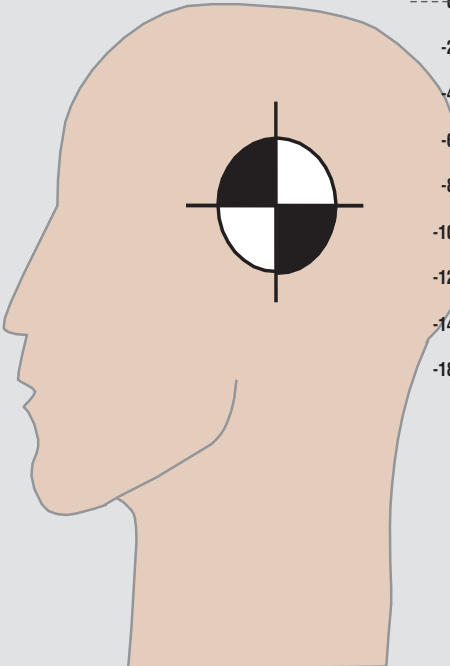
Winners and losers: Among the seat/head restraints that were tested dynamically, the winners are the ones in Volvos (all models) and Saab 9-2X and 9-3 models. These are rated good. So are the seat/head restraints in the Jaguar S-Type, Subaru Impreza, and some Volkswagen New Beetles. The dynamic test performance of the 2004 Toyota Corolla's seat/head restraint also was good, but this car's overall rating is acceptable because the head restraint's geometry is rated acceptable.

A total of 54 seat/head restraint combinations are rated poor overall.

"It's obvious that some automakers are doing a better job than others of designing seats and head restraints to protect their customers' necks in rear crashes," Lund says. "Especially disappointing is that so many car models still have head restraints with poor or marginal geometry. Good geometry is a simple and necessary first step toward adequate protection, and seats with bad geometry cannot begin to protect many taller occupants." Two-thirds of the 24 seats that weren't tested dynamically because of inadequate head restraint geometry are in General Motors cars.

Neck injuries sustained in rear-end crashes seldom are life-threatening, but they can be painful. They occur frequently and are expen-

TWO-STEP RATING



distance above/below head of average-size man (cm)

2	Green	Yellow	Orange	Red
0	Green	Yellow	Orange	Red
-2	Green	Yellow	Orange	Red
-4	Green	Yellow	Orange	Red
-6	Green	Yellow	Orange	Red
-8	Green	Yellow	Orange	Red
-10	Green	Yellow	Orange	Red
-12	Green	Yellow	Orange	Red
-14	Green	Yellow	Orange	Red
-18	Green	Yellow	Orange	Red

backset (cm)

2	Green	Yellow	Orange	Red
4	Green	Yellow	Orange	Red
6	Green	Yellow	Orange	Red
8	Green	Yellow	Orange	Red
10	Green	Yellow	Orange	Red
12	Green	Yellow	Orange	Red
14	Green	Yellow	Orange	Red
16	Green	Yellow	Orange	Red
18	Green	Yellow	Orange	Red

1. GEOMETRY

FIRST THE HEIGHT AND BACK-SET OF HEAD RESTRAINTS ARE EVALUATED ACCORDING TO THIS PROTOCOL, WHICH IS USED INTERNATIONALLY.

sive. In the United States alone, they cost at least \$7 billion in insurance claims per year.

Importance of a good seat/head restraint:

When a vehicle is struck in the rear and driven forward, the vehicle seats accelerate occupants' torsos forward. Unsupported, the occupants' heads will lag behind the forward movement of their torsos. This differential motion causes the neck to bend back 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,"

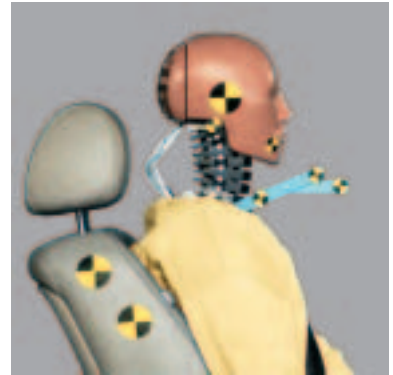
Lund explains. "To ensure they move together, a seat and head restraint have to work in concert to support an occupant's neck and head, accelerating them with the torso as the vehicle is driven forward following a rear impact. To accomplish this, the geometry of the head restraint has to be adequate, and so do the stiffness characteristics of the vehicle seat."

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.

PROCEDURE



NO DYNAMIC TEST



SEATS WITH MARGINAL OR POOR HEAD RESTRAINT GEOMETRY AREN'T TESTED DYNAMICALLY. THEY'RE RATED POOR OVERALL BECAUSE THEIR GEOMETRY IS INADEQUATE TO PROTECT TALLER PEOPLE.

2. DYNAMIC TEST

THEN SEATS WITH GOOD OR ACCEPTABLE HEAD RESTRAINT GEOMETRY ARE EVALUATED IN A SIMULATED REAR IMPACT USING MEASURES RECORDED ON A BIORID DUMMY. OVERALL RATINGS REFLECT BOTH RESTRAINT GEOMETRY AND TEST PERFORMANCE.

"If a head restraint isn't positioned behind an occupant's head, it cannot support the head in a rear impact," Lund adds. "But good head restraint geometry by itself isn't sufficient. A seat also has to be designed so it doesn't rotate backward in a rear impact because this would move the head restraint away from 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. The new evaluation criteria take into account both static restraint geometry and the dynamic performance of seats and head restraints together in tests."

New versus old evaluation procedures:

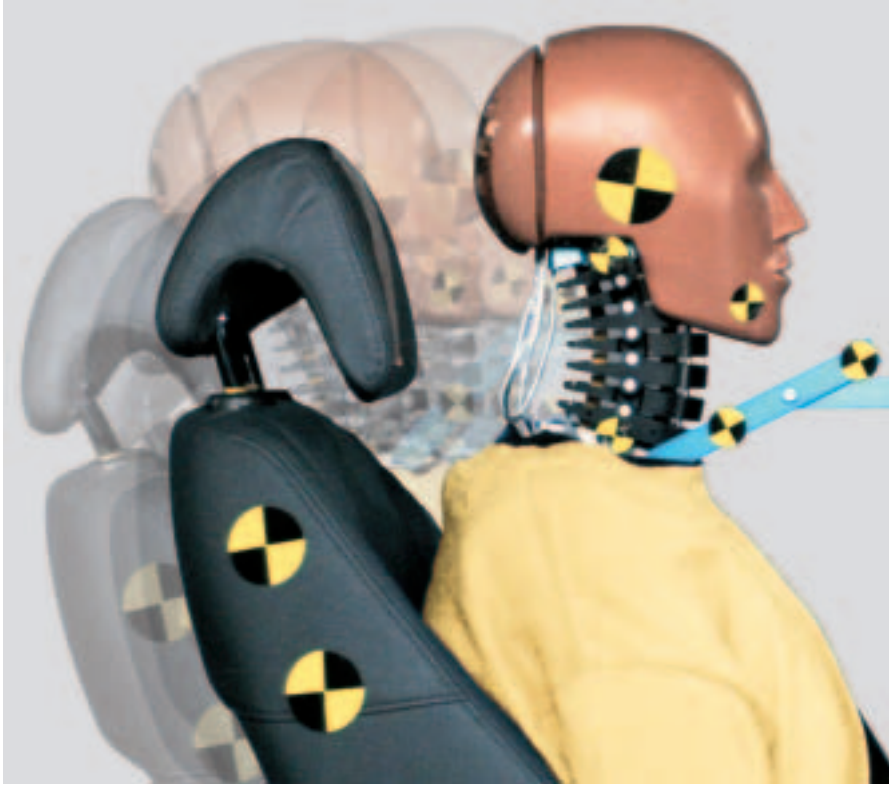
Since 1995 the Institute has been rating the geometry of head restraints in passenger vehicles based on how close the restraints are to the back of the head of an average-size man. In publishing the first ratings, the Institute explained that "good geometry is necessary but not sufficient for good protection. The relative stiffness of the seatbacks also helps determine effectiveness."

Assessing seatback stiffness and other characteristics of whiplash injury prevention requires crash testing or other dynamic assessments that weren't practical in the mid- to late-

1990s. Very few head restraints back then had geometry sufficient to warrant dynamic testing. The geometry of most head restraints was marginal or poor. Such restraints cannot provide adequate protection because they cannot be positioned to support many people's heads during crashes.

Another reason dynamic tests weren't conducted is that there wasn't a test dummy with a realistic spine and neck configuration designed for testing in rear-end crashes at low to moderate speeds. Existing dummies in the mid- to late-1990s had rigid spines and necks that weren't designed to produce human-like responses to rear crash forces.

Since then a new test dummy, BioRID, has been developed that's designed specifically for rear crash testing. Representing an average-size man, BioRID is beginning to be widely used. Plus automakers have improved the geometry of head restraints. The *(continues on p.6)*



CARS SOLD IN EUROPE EARN BETTER RATINGS

MORE RATED GOOD OVERALL, FEWER POOR

Among seat/head restraints the Institute evaluated in dynamic tests, more are rated poor overall (30) than good or acceptable (24). Proportions are better in Europe, where 45 of 88 seat/head restraints tested by Thatcham in the United Kingdom are good or acceptable, and 16 are poor. Another 26 weren't tested dynamically because of inadequate head restraint geometry.

Only 8 of the 73 seat/head restraints the Institute evaluated dynamically earned good ratings. In contrast, 18 European seats are rated good. Besides Volvos, some European Ford, Nissan, Renault, and Seat models earned good overall ratings.

Like the Institute, Thatcham is a member of the International Insurance Whiplash Prevention Group (see p. 6). This U.K. research group conducted the dynamic tests of seats sold in cars in the European market, while the Institute evaluated seats sold in cars in North America.

INTERNATIONAL PROTOCOL FOR RATING SEAT/HEAD RESTRAINTS

Overall ratings are based on a two-step evaluation. First a head restraint's geometry (distance behind and below the top of 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. In the dynamic test, measurements are recorded on a dummy (BioRID) representing an average-size man. Dynamic ratings 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 tension and shear forces recorded on BioRID's neck during the test. The overall ratings of 73 seat/head restraints are based on both geometry and dynamic test results. Twenty-four other seats with marginal or poor head restraint geometry weren't tested dynamically because they cannot protect taller people in rear-end crashes. These seats are rated poor overall.

REAR CRASH PROTECTION RATINGS

based on head restraint
geometry and dynamic
test performance

GOOD	G
ACCEPTABLE	A
MARGINAL	M
POOR	P

Make/model and seat type	OVERALL SEAT/HEAD RESTRAINT RATING	DYNAMIC RATING	SEAT/HEAD RESTRAINT GEOMETRY
ACURA TL ALL SEATS 2004-05 models	M	M	G
ACURA TSX ALL SEATS 2004-05 models	P	P	G
AUDI A4 SEATS THAT ADJUST MANUALLY 2004-05 models	P	P	G
AUDI A4 SEATS WITH POWER ADJUSTMENT 2004-05 models	P	P	A
AUDI S4 ALL SEATS 2004-05 models	P	P	G
AUDI A6 ALL SEATS ACTIVE HEAD RESTRAINTS 2005 models	A	A	G
BMW 3 SERIES ALL SEATS 2002-05 models	P	P	A
BMW 5 SERIES BASE SEATS 2004-05 models	P	P	A
BMW 5 SERIES SPORT SEATS ACTIVE HEAD RESTRAINTS 2004-05 models	A	A	G
CADILLAC CTS SEATS WITHOUT ADJUSTABLE LUMBAR 2003-05 models	P	P	A
CHEVROLET MALIBU ALL SEATS 2004-05 models	A	A	G
CHRYSLER SEBRING SEATS WITH POWER RECLINE 2003-05 models	A	A	G
CHRYSLER 300 ALL SEATS 2005 models	A	A	G
DODGE NEON SEATS WITH ADJUSTABLE HEAD RESTRAINTS 2001-05 models	P	P	A
DODGE STRATUS BASE SEATS 2003-05 models	P	P	G
DODGE STRATUS 8-WAY POWER SEATS 2003-05 models	A	A	A
FORD FOCUS ALL SEATS 2001-05 models	M	M	G
FORD TAURUS ALL SEATS 2004-05 models	M	M	A
FORD CROWN VICTORIA SEATS WITH ADJUSTABLE LUMBAR 2003-05 models	M	M	G
HONDA CIVIC SEATS WITH ADJUSTABLE HEIGHT 2003-05 models	P	P	G
HONDA ACCORD LX MODELS STANDARD SEATS 2003-05 models	P	P	A
HONDA ACCORD EX MODELS STANDARD SEATS 2003-05 models	P	P	G
HYUNDAI ELANTRA ALL SEATS 2001-05 models	P	P	A
HYUNDAI SONATA GL MODELS 2001-05 models	P	P	A
HYUNDAI XG350 ALL SEATS 2002-05 models	P	P	A

Make/model and seat type	OVERALL SEAT/HEAD RESTRAINT RATING	DYNAMIC RATING	SEAT/HEAD RESTRAINT GEOMETRY
INFINITI I35 ALL SEATS ACTIVE HEAD RESTRAINTS 2002-04 models	P	P	A
INFINITI G35 ALL SEATS MFG. AFTER 8/2004 ACTIVE HEAD RESTRAINTS 2005 models	P	P	G
INFINITI Q45 ALL SEATS MFG. AFTER 10/2004 ACTIVE HEAD RESTRAINTS 2005 models	M	M	G
JAGUAR X-TYPE ALL SEATS 2004-05 models	P	P	G
JAGUAR S-TYPE ALL SEATS 2005 models	G	G	G
KIA SPECTRA ALL SEATS ACTIVE HEAD RESTRAINTS 2005 models	A	A	G
KIA OPTIMA SEATS THAT ADJUST MANUALLY 2001-05 models	P	P	A
KIA AMANTI ALL SEATS MFG. AFTER 8/2004 ACTIVE HEAD RESTRAINTS 2005 models	A	A	G
LEXUS IS ALL SEATS 2004-05 models	M	M	G
LEXUS ES ALL SEATS 2004-05 models	P	P	A
LEXUS GS ALL SEATS 2003-05 models	M	M	G
LEXUS LS ALL SEATS 2001-05 models	M	M	G
LINCOLN LS ALL SEATS 2003-05 models	A	A	G
LINCOLN TOWN CAR ALL SEATS 2003-05 models	M	M	A
MAZDA 3 BASE SEATS 2004-05 models	M	M	G
MAZDA 3 SEATS WITH ADJUSTABLE LUMBAR 2004-05 models	M	M	A

Make/model and seat type	OVERALL SEAT/HEAD RESTRAINT RATING	DYNAMIC RATING	SEAT/HEAD RESTRAINT GEOMETRY
MAZDA 6 SEATS WITHOUT ADJUSTABLE LUMBAR 2003-05 models	M	M	G
MAZDA 6 SEATS WITH ADJUSTABLE LUMBAR 2003-05 models	P	P	A
MERCEDES C CLASS SEATS WITH HEAD RESTRAINTS THAT ADJUST AUTOMATICALLY 2004-05 models	M	M	G
MERCEDES E CLASS SEATS WITH HEAD RESTRAINTS THAT ADJUST AUTOMATICALLY 2004-05 models	A	A	G
MERCURY SABLE ALL SEATS 2004-05 models	P	P	A
MERCURY GRAND MARQUIS ALL SEATS 2003-05 models	M	M	A
MINI COOPER ALL SEATS 2002-05 models	M	M	G
MITSUBISHI LANCER ALL SEATS 2002-05 models	M	M	G
MITSUBISHI GALANT CLOTH SEATS 2004-05 models	P	P	A
NISSAN ALTIMA ALL SEATS MFG. AFTER 8/2004 2005 models	A	A	A
SAAB 9-2X ALL SEATS MFG. AFTER 9/2004 ACTIVE HEAD RESTRAINTS 2005 models	G	G	G
SAAB 9-3 ALL SEATS ACTIVE HEAD RESTRAINTS 2005 models	G	G	G
SAAB 9-5 ALL SEATS MFG. AFTER 9/2004 ACTIVE HEAD RESTRAINTS 2005 models	A	A	G
SATURN ION CLOTH SEATS 2003-04 models	P	P	G
SATURN ION LEATHER SEATS 2003-04 models	P	P	A
SUBARU IMPREZA ALL SEATS MFG. AFTER 9/2004 ACTIVE HEAD RESTRAINTS 2005 models	G	G	G

Make/model and seat type	OVERALL SEAT/HEAD RESTRAINT RATING	DYNAMIC RATING	SEAT/HEAD RESTRAINT GEOMETRY
SUBARU IMPREZA WRX ALL SEATS 2004-05 models	M	M	G
SUBARU LEGACY ALL SEATS ACTIVE HEAD RESTRAINTS 2005 models	A	A	G
SUBARU OUTBACK ALL SEATS ACTIVE HEAD RESTRAINTS 2005 models	A	A	G
SUZUKI AERIO ALL SEATS 2002-05 models	M	M	G
SUZUKI FORENZA ALL SEATS 2004 models	P	P	A
SUZUKI VERONA ALL SEATS 2004-05 models	P	P	A
TOYOTA COROLLA ALL SEATS 2003-04 models	A	G	A
TOYOTA COROLLA ALL SEATS 2005 models	P	P	A
TOYOTA CAMRY CLOTH SEATS 2002-04 models	M	M	G
TOYOTA CAMRY LEATHER SEATS 2002-04 models	P	P	A
TOYOTA AVALON ALL SEATS 2001-04 models	P	P	A
VOLKSWAGEN NEW BEETLE SEATS WITHOUT ADJUSTABLE LUMBAR ACTIVE HEAD RESTRAINTS 2004-05 models	A	A	G
VOLKSWAGEN NEW BEETLE SEATS WITH ADJUSTABLE LUMBAR ACTIVE HEAD RESTRAINTS 2004-05 models	G	G	G
VOLVO S40 ALL SEATS MFG. AFTER 2/2004 2004-05 models	G	G	G
VOLVO S60 ALL SEATS 2003-05 models	G	G	G
VOLVO S80 ALL SEATS 2003-05 models	G	G	G

RATINGS

of seats that weren't dynamically tested because of inadequate head restraint geometry

NOTE: Seats with head restraints rated marginal or poor, based on geometry, aren't tested dynamically because they cannot protect taller people in rear-end crashes. These seats are rated poor overall.

GOOD	G
ACCEPTABLE	A
MARGINAL	M
POOR	P

Make/model and seat type	OVERALL SEAT/HEAD RESTRAINT RATING	DYNAMIC RATING	SEAT/HEAD RESTRAINT GEOMETRY
ACURA RL ALL SEATS 2001-04 models	P	not tested	P
BUICK CENTURY CLOTH SEATS 2001-05 models	P	not tested	M
BUICK CENTURY LEATHER SEATS 2001-05 models	P	not tested	P
BUICK REGAL ALL SEATS 2001-04 models	P	not tested	P
BUICK LESABRE ALL SEATS ACTIVE HEAD RESTRAINTS 2003-05 models	P	not tested	P
BUICK PARK AVENUE ALL SEATS 2003-05 models	P	not tested	P
CADILLAC SEVILLE ALL SEATS 2001-04 models	P	not tested	P
CHEVROLET CAVALIER ALL SEATS 2001-05 models	P	not tested	P
CHEVROLET CLASSIC (formerly Malibu) CLOTH SEATS 2003-05 models	P	not tested	M
CHEVROLET CLASSIC (formerly Malibu) LEATHER SEATS 2003-05 models	P	not tested	P
CHEVROLET IMPALA CLOTH BUCKET SEATS 2001-05 models	P	not tested	M
CHEVROLET IMPALA LEATHER BUCKET SEATS 2001-05 models	P	not tested	P
CHRYSLER SEBRING SEATS THAT RECLINE MANUALLY 2003-05 models	P	not tested	M
HONDA CIVIC BASE SEATS 2003-05 models	P	not tested	M
MITSUBISHI GALANT LEATHER SEATS 2004-05 models	P	not tested	M
NISSAN SENTRA BASE SEATS 2002-05 models	P	not tested	P
NISSAN MAXIMA CLOTH SEATS ACTIVE HEAD RESTRAINTS 2004 models	P	not tested	P
NISSAN MAXIMA LEATHER SEATS ACTIVE HEAD RESTRAINTS 2004 models	P	not tested	M
PONTIAC GRAND AM CLOTH SEATS 2001-05 models	P	not tested	M
PONTIAC GRAND PRIX ALL SEATS 2004 models	P	not tested	M
PONTIAC BONNEVILLE BENCH SEATS ACTIVE HEAD RESTRAINTS 2003-05 models	P	not tested	P
PONTIAC BONNEVILLE LEATHER SEATS ACTIVE HEAD RESTRAINTS 2003-05 models	P	not tested	M
SATURN I SERIES ALL SEATS 2001-05 models	P	not tested	P
VOLKSWAGEN PASSAT ALL SEATS 2001-05 models	P	not tested	M

(continued from p.3) Institute's first evaluations, which involved 1995 models, found only 5 seats with good geometry. In contrast, 80 percent of the head restraints in 2004 models have good or acceptable geometry. Some models also are being equipped with new head restraints designed to move closer to the backs of people's heads during rear impacts. Dynamic testing is required to evaluate these "active" restraints and seatbacks that are specially designed to reduce acceleration forces.

Ratings are released internationally: Recognizing the improvements in head restraint geometry and the need to move beyond ratings based solely on geometry, the Institute joined with other whiplash injury prevention experts in late 2000 to organize the International Insurance Whiplash Prevention Group (IIWPG). In addition to the Institute, IIWPG members include the following research organizations supported by automobile insurers: Thatcham in the United Kingdom; Allianz Centre for Technology in Germany and the German Insurance Institute for Traffic Engineering; Folksam Insurance in Sweden; ICBC in Canada; Insurance Australia Group; and CESVIMap in Spain.

IIWPG conducted extensive research and testing to develop the procedures for the dynamic test and evaluation criteria that have been used by member research groups, including the Institute, to rate the performance of more than 200 seat/head restraint combinations in vehicles sold in a number of world markets. Earlier this week, the ratings were released simultaneously by IIWPG partners in Australia, Canada, Germany, and the United Kingdom as well as by the Institute in the United States.

IIWPG rating procedures: Overall seat/head restraint ratings shown on the previous pages are based on a two-step evaluation. In the first step restraint geometry is rated, using the same procedures as before (see p. 2). Seats with good or acceptable geometric ratings then are subjected to a dynamic test conducted on a sled that simulates the forces in a stationary vehicle that's rear-ended by another vehicle of the same weight going 20 mph.

The dynamic test 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 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 the neck, the better the dynamic rating.

A seat/head restraint's dynamic rating is combined with its geometric rating to produce an overall rating. The 73 overall ratings (see previous pages) represent more seat/head restraint combinations than are listed. When the ratings for a car model's seat options are the same, these ratings are combined.

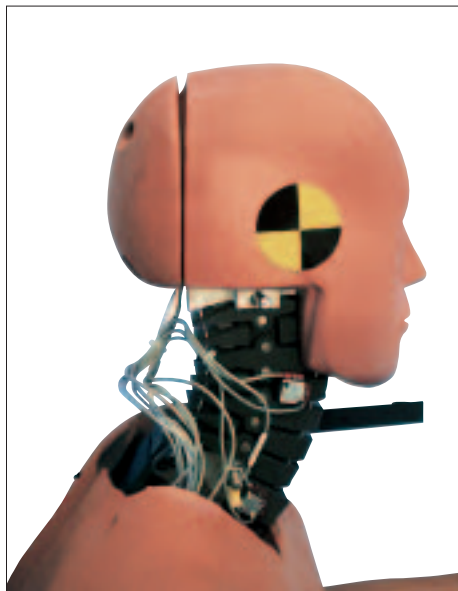
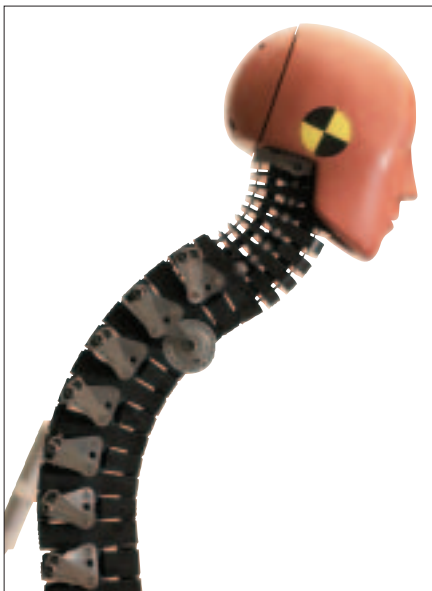
Sled test sets tougher standard: Nine seat/head restraints rated good for geometry and another 21 with acceptable geometry turned in poor performances in the dynamic test.

"The principal reason for the failing dynamic performances of these seats was that the seatbacks rotated backward in the test," Lund says. "This moved the head restraint farther from the dummy's head, so initial contact with the head restraint took longer. The result was that the dummy's head wasn't supported in time to reduce the differential motion of the head and torso that leads to neck injury. So, although the auto manufacturers have been improving the geometry of the head restraints in their cars, in many cases they need to make further improvements to their seats and head restraints."

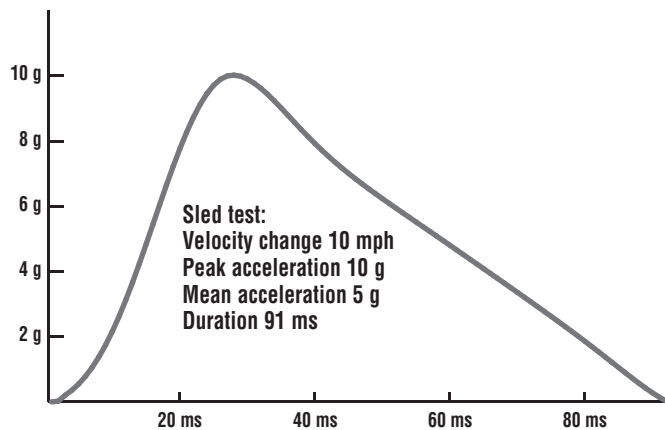
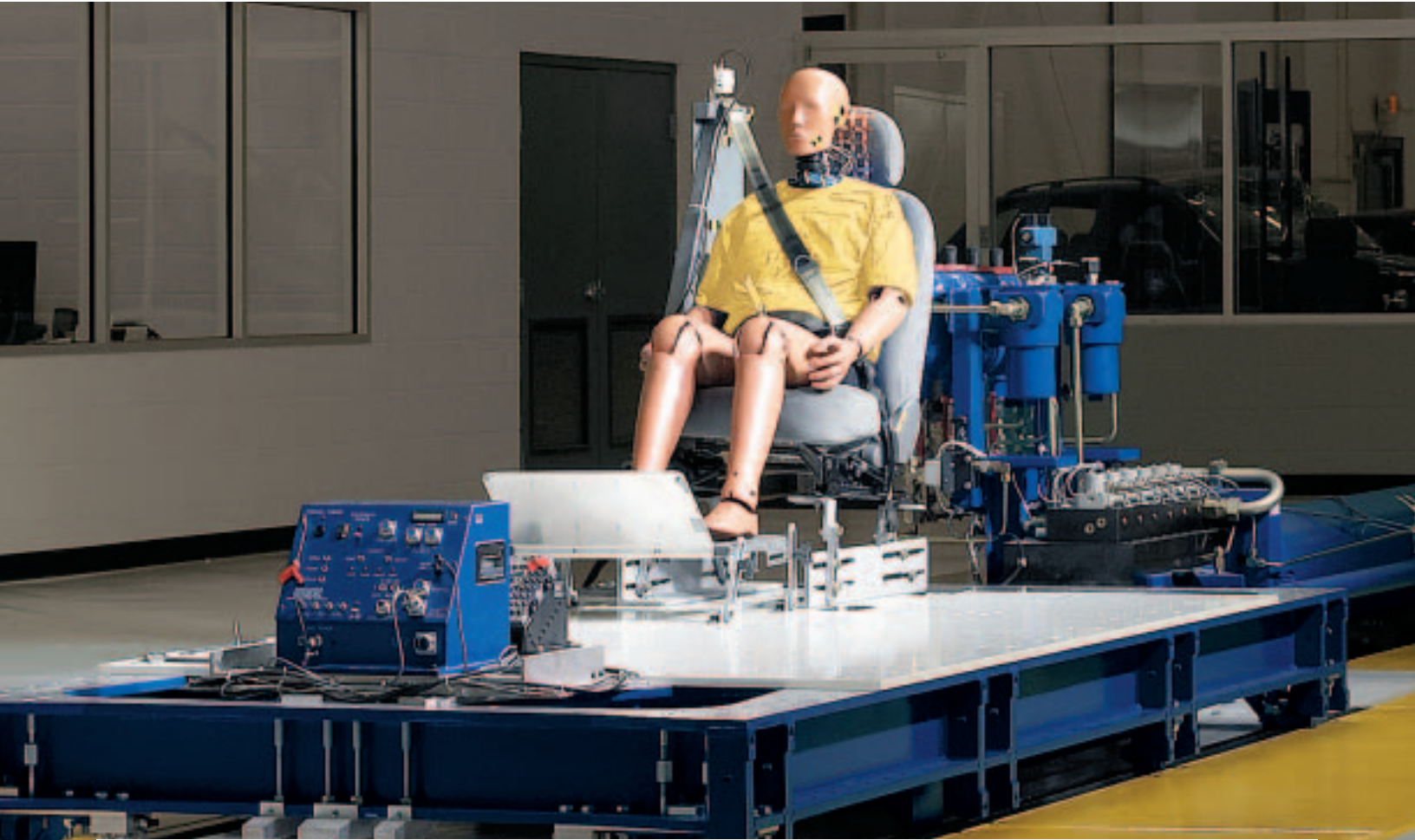
Saabs and Volvos are winners: The seat/head restraint combinations in two Saab models and three Volvos are rated good, but the designs of these systems aren't the same. As an occupant's torso sinks into a Saab seat during a rear crash, a mechanism in the seatback is designed to push the head restraint up and toward the back of the head. Volvo took a different approach, designing seatbacks with a special hinge to reduce the forward acceleration of an occupant's torso.

"The designs are different, but the result is the same," Lund points out. "Both Volvo and Saab have found a way to reduce the differential motion of an occupant's head and torso that causes neck injury in rear crashes. This is what we want every automaker to do."

Institute research released in 2002 indicated that fewer neck injury claims are filed for Volvos and Saabs with the advanced seat/head restraint systems, compared with older models of the same cars without such systems (see *Status Report*, Oct. 26, 2002; on the web at ihs.org).



BIORID IS DESIGNED TO PRODUCE HUMAN-LIKE RESPONSES IN REAR IMPACTS. BEFORE THIS DUMMY, THERE WASN'T ONE WITH A REALISTIC SPINE AND NECK FOR USE IN REAR TESTING AT LOW TO MODERATE SPEEDS.



DYNAMIC TESTS OF SEAT/HEAD RESTRAINTS ARE CONDUCTED ON A SLED THAT SIMULATES THE FORCES ON PEOPLE IN A STATIONARY VEHICLE REAR-ENDED BY ANOTHER VEHICLE OF THE SAME WEIGHT GOING 20 MPH. THIS ACCELERATES THE STRUCK VEHICLE FROM 0 TO 10 MPH. THIRTY SEATS WITH GOOD OR ACCEPTABLE HEAD RESTRAINT GEOMETRY FAILED THIS TEST.

STATUS REPORT

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SPECIAL ISSUE

New seat/head restraint ratings compare protection in rear-end crashes based on dynamic test performance as well as restraint geometryp.1

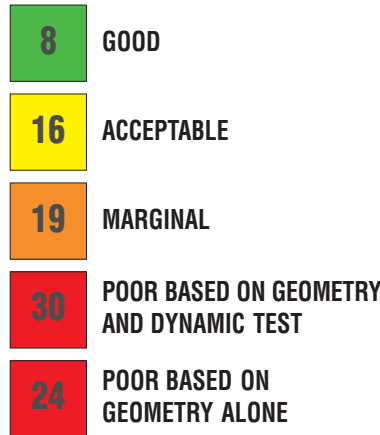
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HOW THEY RATE SEAT/HEAD RESTRAINTS IN CARS SOLD IN U.S. MARKET



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