Behind the Scenes of Active Safety Technology Testing – and What's Coming Next

Minnesota TZD

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Manager of Active Safety Testing
IIHS is an independent, nonprofit scientific and educational organization dedicated to reducing deaths, injuries, and property damage from motor vehicle crashes through research and evaluation and through education of consumers, policymakers and safety professionals.

HLDI 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.

Both organizations are wholly supported by auto insurers.
Crash avoidance features are preventing crashes

**Forward collision warning**
- 27% Front-to-rear crashes
- 20% Front-to-rear crashes with injuries
- 9% Claim rates for damage to other vehicles
- 17% Claim rates for injuries to people in other vehicles
- 44% Large truck front-to-rear crashes

**Forward collision warning plus autobrake**
- 50% Front-to-rear crashes
- 56% Front-to-rear crashes with injuries
- 14% Claim rates for damage to other vehicles
- 24% Claim rates for injuries to people in other vehicles
- 41% Large truck front-to-rear crashes

**Blind spot detection**
- 14% Lane-change crashes
- 23% Lane-change crashes with injuries
- 7% Claim rates for damage to other vehicles
- 9% Claim rates for injuries to people in other vehicles

**Rear automatic braking**
- 78% Backing crashes (when combined with rearview camera and parking sensors)
- 10% Claim rates for damage to the insured vehicle
- 28% Claim rates for damage to other vehicles

**Rearview cameras**
- 17% Backing crashes

**Rear cross-traffic alert**
- 22% Backing crashes
Front AEB testing
Front crash prevention ratings
Tests conducted at 12 and 25 mph

- **BASIC**
  - The vehicle has a forward collision warning system that meets National Highway Traffic Safety Administration performance criteria

- **ADVANCED**
  - The vehicle has an autobrake system that avoids a crash or significantly reduces the speed in 1 of 2 tests

- **SUPERIOR**
  - The vehicle has an autobrake system that avoids a crash or substantially reduces the speed in both tests
Current front crash prevention testing
Speed reduction in 12 and 25 mph tests

Volvo S60
Dodge Durango
Subaru Outback
Front crash prevention ratings for 2013-21 model years
As of March 2022
20 automakers (99+% of the U.S. market) have committed to making autobrake standard by September 2022.
“10 automakers fulfill automatic emergency braking pledge ahead of schedule”

–Consumer Reports / December 17, 2020

Vehicles equipped with AEB as built for the U.S. market during the period Sep. 1, 2019 through Aug. 31, 2020
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**Lane departure warning**
- 11% Single-vehicle, sideswipe and head-on crashes
- 21% Injury crashes of the same types

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Rear crash prevention test scenarios

- Reversing car-to-car, 16” overlap
- Reversing car-to-car, 45° angle
- Reversing car-to-car, 10° angle
- Reversing toward fixed pole
Rear crash prevention test scenarios
Rear crash prevention ratings

- **SUPERIOR**: Vehicles with rear parking sensors, rear cross traffic alert, and the best performing rear autobrake systems
- **ADVANCED**: Vehicles with rear parking sensors, rear cross traffic alert, and more capable rear autobrake system
- **BASIC**: Vehicles with parking sensors and/or RCTA and minimal rear autobrake performance
- Vehicles with rear cross traffic alert only
- Vehicles with parking sensors only
- Vehicles with cross traffic alert and parking sensors
Benefit of rear autobrake
IIHS headlight evaluations and industry progress
Driving at night is 3 times riskier than driving during the day

Why are headlights important?

- Miles driven: 22% (Daylight), 78% (Dark/low light)
- All fatalities: 47% (Daylight), 52% (Dark/low light)
- Pedestrian & bicyclist fatalities: 24% (Daylight), 75% (Dark/low light)
Change in claim frequency associated with the presence of curve-adaptive headlights

-15%  -10%  -5%  0%  5%  10%

Acura  BMW  General Motors  Mazda  Mercedes-Benz  Subaru  Volvo  Weighted average

-10%  -15%

Property damage liability  Collision  Statistically significant

Weighted average
Human factors experiments have established a link between lighting and detection performance.
Federal regulation allows for wide range of on-road visibility
IIHS dynamic headlight test

Vehicle approaches

Direction of travel

500 ft. radius curves at 40 mph

800 ft. radius curves at 50 mph

Light sensor arrays

Straightaway at 40 mph
IIHS dynamic headlight test

Illuminance readings

Visibility
- Edges of the road
- 10 inches above ground

Glare
- Center of oncoming lane
- 3 feet, 7 inches above ground
IIHS headlight releases

- **Midsize cars**
  - March 2016
  - 31 models
  - 82 headlights

- **Small SUVs**
  - July 2016
  - 21 models
  - 47 headlights

- **Pickup trucks**
  - October 2016
  - 11 models
  - 23 headlights

- **Midsize SUVs**
  - June 2017
  - 37 models
  - 79 headlights
Improvements
Best-rated headlight for 2016-21 models
As of March 2022

<table>
<thead>
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<th>Year</th>
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</table>
As of March 2022
All headlight ratings for 2016-21 models
As of March 2022
Decreasing glare
Average low-beam glare by model year

Increase in glare
Allowable glare
Decrease in glare

Ford Edge

Ford Bronco Sport
Increasing low-beam visibility

Average low-beam visibility distance by model year
Genesis service campaign
2021 Genesis G80

Marginal
Genesis service campaign

2021 Genesis G80

Marginal

Acceptable
What is the purpose of the service campaign?

The Insurance Institute for Highway Safety (IIHS) is a well-known organization that conducts supplemental testing to evaluate certain aspects of the vehicle performance. As a result of such testing, Genesis and IIHS have determined that improvements could be made to adjust headlight aim, to improve the focus and reduce glare from the headlights to oncoming traffic.
2021 Genesis G80

2021 IIHS TOP SAFETY PICK+

The Insurance Institute for Highway Safety (IIHS) announced that the all-new 2021 Genesis G80 executive sedan has been designated as TOP SAFETY PICK+ (TSP+) for 2021. With this designation, G80 completes the 2021 Genesis lineup sweep of top honors, joining the GV80 SUV, G70 sport sedan, and G90 flagship sedan. This marks the third year in a row that G80 has earned top honors along with G70 and G90 all having received TOP SAFETY PICK+ designations in 2019, 2020, and 2021.
Nighttime crash risk relative to poor-rated headlights

-30% -25% -20% -15% -10% -5% 0% 5%

-30% -25% -20% -15% -10% -5% 0% 5%

Good vs. poor Acceptable vs. poor Marginal vs. poor Statistically significant

All Animal Driver injury Pedestrian/cyclist Tow-away
IIHS Pedestrian Testing
U.S. pedestrian fatalities
1975-2020

59%
Upward trend in pedestrian deaths

- Highest increases occurred in scenarios with most pedestrian deaths
  - Urban areas
  - Arterials
  - Nonintersections
  - Dark
- Higher increases among age group 20-69 and pedestrians not impaired by alcohol
- Increasing popularity of SUVs and vehicle power associated with increased risk of pedestrian deaths
Pedestrian front crash prevention testing began in late 2018
Pedestrian Test Scenarios

**Adult walking from right side**
- Vehicle speed: 20 & 40 km/h
- Pedestrian Speed: 5 km/h
- Impact location: 25%

**Child running from right side**
- Vehicle Speed: 20 & 40 km/h
- Pedestrian Speed: 5 km/h
- Impact location: 50%

**Stationary adult in traffic lane**
- Vehicle speed: 40 & 60 km/h
- Pedestrian Speed: 0 km/h
- Impact location: 25%
# Pedestrian Rating
Small SUV release – February 21, 2019

<table>
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<tr>
<th>SUPERIOR</th>
<th>2018-19 Honda CR-V</th>
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<tr>
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<td>2019 Subaru Forester</td>
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<tr>
<td></td>
<td>2019 Toyota RAV4</td>
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<td>2019 Volvo XC40</td>
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<tr>
<th>ADVANCED</th>
<th>2019 Chevrolet Equinox</th>
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<tr>
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<td>2018-19 Hyundai Kona</td>
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<tr>
<td></td>
<td>2019 Kia Sportage</td>
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<tr>
<td></td>
<td>2018-19 Mazda CX-5</td>
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<tr>
<td></td>
<td>2019 Nissan Rogue</td>
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</tbody>
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| BASIC          | 2019 Mitsubishi Outlander|

| NO CREDIT      | 2018-19 BMW X1           |
# Pedestrian Rating

## Midsize car release – October 29, 2019

**Superior**

- 2019 Audi A4 standard
- 2019-20 BMW 3 series standard
- 2020 Subaru Outback standard
- 2019-20 Mercedes-Benz C-Class optional
- 2019-20 Volvo S60 standard

**Advanced**

- 2019-20 BMW 3 series optional
- 2019-20 Honda Accord standard
- 2019-20 Lexus ES 350 standard
- 2019 Mazda 6 standard
- 2019-20 Nissan Altima optional
- 2019-20 Tesla Model 3 standard
- 2019-20 Toyota Camry standard

**Basic**

- 2019-20 Chevrolet Malibu optional camera only
- 2019-20 Chevrolet Malibu optional camera + radar
- 2019-20 Mercedes-Benz C-Class standard

**No Credit**

- 2019-20 Ford Fusion standard
- 2019 Hyundai Sonata optional
- 2019-20 Kia Optima optional
Pedestrian front crash prevention ratings

2019
- Not available: 44%
- Superior: 21%
- Advanced: 28%
- No credit: 3%
- Basic: 5%

2021
- Superior: 46%
- Advanced: 35%
- Not available: 13%
- No credit: 1%
- Basic: 6%

2021 vs. 2019
- Superior ratings increased from 21% to 46%.
- Advanced ratings increased from 28% to 35%.
- Basic ratings decreased from 5% to 6%.
- Not available ratings decreased from 44% to 13%.
- No credit ratings increased from 3% to 1%.
HLDI analysis: Subaru EyeSight and pedestrians

Pedestrian-related insurance claims reduced by 35%
Effects of pedestrian automatic emergency braking (AEB) on police-reported pedestrian crashes

- Pedestrian crashes: -40%
- Pedestrian injury crashes: -30%
- Pedestrian serious/fatal injury crashes: -20%

Statistically significant
Pedestrian crashes and fatalities

By light condition

- Daylight
- Dark
- Dark but lighted
- Dawn/dusk

- All crashes
- Fatal crashes
Effect of pedestrian AEB on the odds of a pedestrian crash

By light condition

Daylight: -40%

Dark and lighted, dawn, dusk: -20%

Dark and unlighted: 0%

Statistically significant
Pedestrian target at 50 feet
Nighttime crash risk relative to poor-rated headlights

- 30%
- 20%
- 10%
0%

- All crashes
- Driver injury
- Pedestrian
- Animal

Good vs. poor rating
Acceptable vs. poor rating
Marginal vs. poor rating
Statistically significant
Night pedestrian front crash prevention test scenarios

- **Perpendicular adult**
  - Adult walks across road
  - Tests run at 12 & 25 mph

- **Perpendicular child**
  - Child runs into road; parked vehicles obstruct view
  - Tests run at 12 & 25 mph

- **Parallel adult**
  - Adult in right lane near edge of road, facing away from traffic
  - Tests run at 25 & 37 mph
High beam 25 mph

Low beam 25 mph
Night pedestrian front crash prevention test vehicles
By headlight rating

2021 Ford Bronco Sport
2020 Honda CR-V
2021 Toyota CH-R
2022 Volkswagen Taos
2019 Volvo XC40

2021 Chevrolet Trailblazer
2020 Hyundai Venue
2019 Subaru Forester
2021 Toyota CH-R
Night pedestrian front crash prevention test vehicles

By AEB technology

2021 Ford Bronco Sport
2020 Honda CR-V
2021 Toyota CH-R
2022 Volkswagen Taos
2019 Volvo XC40
2021 Chevrolet Trailblazer
2020 Hyundai Venue
2019 Subaru Forester
2021 Toyota CH-R

Camera
Radar
Average speed reductions in pedestrian tests

- Ford Bronco Sport: 0%
- Honda CR-V: Daylight 100%, High beams 80%, Low beams 60%
- Toyota C-HR: Daylight 100%, High beams 80%, Low beams 60%
- Volkswagen Taos: Daylight 100%, High beams 80%, Low beams 60%
- Volvo XC40: Daylight 100%, High beams 80%, Low beams 60%
- Chevy Trailblazer: Daylight 100%, High beams 80%, Low beams 60%
- Hyundai Venue: Daylight 100%, High beams 80%, Low beams 60%
- Subaru Forester: Daylight 100%, High beams 80%, Low beams 60%
- Toyota C-HR: Daylight 100%, High beams 80%, Low beams 60%
Most pedestrian AEB systems perform well in our current test

Pedestrian AEB is preventing crashes

Fatal pedestrian crashes occur more often in the dark

Better rated headlights help drivers see pedestrians and prevent crashes at night

IIHS plans to launch night pedestrian front crash prevention later this year
IIHS safeguards ratings for partial driving automation
Some drivers misuse partially automated systems
IIHS issued recommendations for keeping drivers engaged

March 2020

IIHS recommends new safeguards for partially automated driving systems

IIHS has issued a set of research-based safety recommendations on the design of partially automated driving systems. The guidelines emphasize how to keep drivers focused on the road even as the vehicle does more of the work.

Today’s partially automated systems still need the driver to be involved at all times. That means they need robust methods of monitoring driver engagement and more effective ways of regaining the driver's attention when it wavers. Designs should also be based on a principle of shared control, and they should have built-in limits that prevent them from being used on roads and under conditions where it isn’t safe to do so, IIHS researchers say.

As part of that philosophy of shared control, partially automated systems shouldn’t change lanes or overtake other vehicles without driver input. They should also be responsive to driver steering input even when automatic lane centering is engaged.

“Unfortunately, the more sophisticated and reliable automation becomes, the more difficult it is for drivers to stay focused on what the vehicle is doing,” says IIHS President David Harley. “That’s why systems should be designed to keep drivers actively engaged.”

Under the classification system developed by SAE International, there are five levels of automation, ranging from 0 (no automation) to 5 (fully self-driving). The highest level available in production vehicles today is Level 2. These systems continuously control acceleration, braking, and steering to keep the vehicle traveling at a set speed in the center of its lane while maintaining a selected following distance from the vehicle ahead. They require the human driver to remain vigilant and ready to intervene in the event that the system encounters a situation it cannot handle.

Despite these limitations, some designs make it too easy for the driver to rely heavily on the system and lack safeguards to make sure he or she remains actively engaged in the driving.

The IIHS researchers reviewed dozens of academic studies to develop a series of recommendations for how manufacturers can better ensure that users remain focused on what’s happening on the road.

One key recommendation is for a specific series of attention reminders to bring the driver’s focus back to the road as outlined in the graphic below.

What behaviors should be monitored?

How should the system respond if the driver is not paying attention?

Should the system have extra capabilities?
IIHS safeguards for partial driving automation ratings program

Sets minimum expectations for automakers to design systems that deter misuse through:

- **Attention reminders**
- **Driver monitoring**
- **Emergency escalation**

- Responsible application of automated functionality
- Cooperation between driver and automation
- Safety feature use

- Program does not endorse partial driving automation
- It is technology neutral to encourage innovative solutions
- Safeguard categories are data-driven and will continue to evolve
Safeguards will be rated good, acceptable, marginal or poor

Currently working on an official protocol

Expect to issue the first set of ratings later this year
Questions?