

Status Report

Insurance Institute for Highway Safety | Highway Loss Data Institute

Night vision

Headlights improve, but base models leave drivers in the dark

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Since most car buyers don't test-drive vehicles at night, IIHS ratings help consumers find ones with the best headlights.

Just over half of 2018 model vehicles IIHS evaluated are available with headlights that do an adequate job of lighting the road at night and limiting glare for oncoming drivers, but most good-rated headlights are optional or bundled with features that can raise the price of the vehicle.

"Consumers shouldn't have to buy a fully loaded vehicle to get the headlights they need to safely drive at night," says David Aylor, manager of active safety testing at IIHS. "All new vehicles should come with good headlights."

Since the Institute released its first headlight ratings for passenger vehicles in 2016, most manufacturers have focused on improving this key safety component (see *Status Report*, March 30, 2016, at iihs.org). That year, only 2 of 95 headlight systems on 2016-model vehicles IIHS evaluated earned a good rating.

For the 2018 model year, the best-available headlights on 32 of 165 models evaluated earn the highest rating of good, and the best-available headlights on 58 models earn the second-highest rating of acceptable. Thirty-two models have only marginal-rated headlights, while poor-rated headlights are the only ones available for 43 models.

Good-rated headlights are needed to qualify for a 2018 *TOP SAFETY PICK+* award, and good- or acceptable-rated headlights are a requirement for *TOP SAFETY PICK*. The Institute is evaluating headlights on contenders for the 2019 awards, which will be announced in December.

A single model may have several different headlight options, and the Institute tries to test all of them as the vehicles arrive on dealer lots. In all, IIHS engineers evaluated 424 headlight variants on 2018 models. Of these, 67 percent earn a marginal or poor

rating because of inadequate visibility, excessive glare from low beams for oncoming drivers, or both.

The Genesis G90, a large luxury sedan, and the Lexus NX, a midsize luxury SUV, are the only 2018 models evaluated that come with good-rated headlights, no matter the trim line or options package. The best-available headlights on the Chevrolet Volt, Genesis G80, Mercedes-Benz E-Class and Toyota Camry are rated good, while the lowest are rated acceptable.

Fifteen other models have acceptable-rated headlights across the board.

Trim line matters

For most other vehicles, though, the difference in headlight performance among trim lines is night and day.

A case in point is the Hyundai Kona. The good-rated LED projector headlights



- ▲ Hyundai Sonata with good-rated LED projector headlights
- ◀ Hyundai Sonata with poor-rated halogen projector headlights

Good vs. poor headlights

Target distances – pedestrian 140 feet, deer 220 feet



The Kona's LED projector low beams cast enough light for a driver to spot the pedestrian and deer straight ahead. In comparison, the halogen projector low beams don't light up enough of the road for the driver to see the targets at the same distance.

on the high-end Kona illuminated almost 450 feet on the right side of the road in the straightaway test for low beams, but the small SUV's poor-rated base-model halogen projector low beams only illuminated 220 feet on the right side of the straightaway, far short of the optimal 325 feet to provide at least 5 lux illumination.

"The Kona's LED low beams should give a driver traveling straight at 65 mph enough time to identify an obstacle in the road and brake to a stop," Aylor says. "In contrast, someone with the halogen lights would need to drive 25 mph slower to have

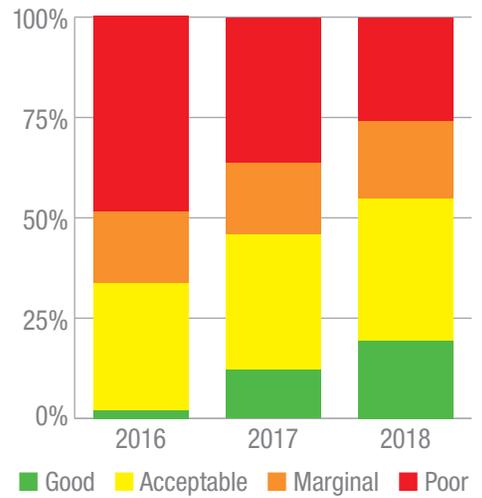
enough time to react to avoid a crash."

The Kona is among the 17 vehicles with good-rated headlights that also have poor-rated variants.

The Hyundai Sonata and its twin, the Kia Optima, are in this group, too. Consumers have to pick a top trim line to get the best available headlights — on 2018 models, the Limited trims built after September 2017 for the Sonata and the SX trim with the SX Technology package for the Optima.

"In the past two years, manufacturers have made changes to improve headlights, whether through better aim or the »

Ratings for the best-available headlights have improved over 3 model years.



All headlights on these 2018 models have good or acceptable ratings.

Vehicle	Highest rating	Lowest rating
Genesis G90	Good	Good
Lexus NX	Good	Good
Chevrolet Volt	Good	Acceptable
Genesis G80	Good	Acceptable
Mercedes-Benz E-Class	Good	Acceptable
Toyota Camry	Good	Acceptable
Acura MDX	Acceptable	Acceptable
Acura RDX	Acceptable	Acceptable
Acura RLX	Acceptable	Acceptable
Acura TLX	Acceptable	Acceptable
BMW X2	Acceptable	Acceptable
BMW X5	Acceptable	Acceptable
Jeep Cherokee	Acceptable	Acceptable
Lexus IS	Acceptable	Acceptable
Tesla Model 3	Acceptable	Acceptable
Toyota Corolla	Acceptable	Acceptable
Toyota Highlander	Acceptable	Acceptable
Toyota Prius	Acceptable	Acceptable
Toyota Prius Prime	Acceptable	Acceptable
Toyota Sienna	Acceptable	Acceptable
Volvo XC60	Acceptable	Acceptable

NHTSA opens door to adaptive-driving-beam headlights to light up road without glare

A potential change to the Federal Motor Vehicle Safety Standard (FMVSS) for headlights would allow auto manufacturers to begin incorporating adaptive-driving-beam headlights in the vehicles they sell in the U.S.

FMVSS 108 to set performance standards and compliance tests for adaptive-driving-beam headlights. Comments are due by Dec. 11.

Automakers who already provide adaptive-driving-beam headlights on vehicles they sell



IIHS-HLDI Board of Directors members preview an adaptive-driving-beam headlight system from Mercedes-Maybach during a September meeting at the Vehicle Research Center. Adaptive driving beams are used in Europe, Japan and other markets but currently are prohibited in the U.S.

Headlights with an adaptive-driving beam are similar to high-beam assist. However, instead of switching the high beams on and off, they continuously adjust the high-beam pattern to create a shadow around other vehicles, based on input from a forward-looking camera. The result is high-beam visibility without the glare for oncoming or lead drivers.

Adaptive-driving beams are used in Europe, Japan and other markets but are prohibited in the U.S. because federal rules require distinct high- and low-beam patterns. As currently written, FMVSS 108 doesn't allow for a headlight system that dynamically adjusts to simultaneously meet portions of the low-beam and high-beam requirements.

In 2013, Toyota petitioned the National Highway Traffic Safety Administration (NHTSA) to amend the federal safety standard for lighting to allow manufacturers to equip vehicles with the systems. The agency in October granted Toyota's request and issued a notice of proposed rulemaking to modify

in other countries would have to modify them for the U.S. market to meet NHTSA's proposed test criteria.

"The Institute welcomes rulemaking that would allow more advanced headlights," says Matthew Brumbelow, a senior research engineer at IIHS. "Adaptive-driving-beam headlights in general provide better illumination of dark roads than traditional headlights and shield oncoming drivers from bothersome glare."

The move comes amid concern about an increase in pedestrian deaths and injuries in crashes. In announcing the proposed rulemaking, NHTSA noted findings of a recent IIHS study indicating a 56 percent rise in pedestrian deaths in the dark from 2009 to 2016 (see *Status Report*, May 8, 2018, at iihs.org).

The National Transportation Safety Board in September urged NHTSA to revise FMVSS 108 to allow adaptive headlight systems that automatically adjust their intensity as one way to improve pedestrian safety by helping drivers see them sooner and slow down. ■

(« from p. 3) light source itself," Aylor says. "But we still see a lot of models where the base headlight is poor, so buyers really have to do their homework to make sure they are getting the best available headlights."

He adds, "Unless you go for a test drive at night, IIHS ratings are the only way to know whether the vehicle you're considering will have good headlights."

Toyota and its Lexus luxury brand lead the way with the most 2018 models that only offer headlights that rate good or acceptable. Still, three Toyota models — the 4Runner, C-HR and Yaris iA — are only available with poor headlights.

The 4Runner's halogen projector headlights, for instance, rate poor because the midsize SUV's low beams don't provide enough light on gradual and sharp curves, and they also create some glare. Light from the high beams is inadequate on sharp curves.

Most headlights use one of three light sources: halogen, high-intensity discharge (HID) or LED. Each of these can be paired with either a multifaceted reflector or a projector lens. Projector headlights use one lens to spread the light out, while reflectors use shiny surfaces that bounce the light forward.

Domestic manufacturers, in general, have room for improvement, especially when it comes to pickup trucks. Poor-rated headlights are the only ones available on Ford's popular F-150 and Chevrolet's Silverado 1500, for example. That is also the case for the Chevrolet Colorado, GMC Canyon and Nissan Frontier.

"Pickups are proportionally more likely than cars to be involved in fatal single-vehicle run-off-the-road crashes. Better headlights might help reduce crashes like these at night," Aylor says.

The Honda Ridgeline is the only pickup with available headlights that earn a good rating. Consumers will have to go for one of the top two trim lines to get them, though, paying nearly \$12,000 more than the base model, which only comes with poor-rated headlights.

Bundling advanced safety features with things like leather seats and »

Consumers may be surprised at repair bills if headlights are damaged in a minor crash

Low-profile hoods and bumpers look sleek but leave expensive headlights vulnerable to damage in even minor fender-benders.

As part of its headlight evaluations, IIHS gathered price data on original equipment

manufacturer (OEM) headlights. Replacing just one front headlight on two-thirds of the good-rated vehicles costs more than \$1,000, far exceeding the typical insurance deductible of \$500.

All of the good-rated headlights are LEDs or high-intensity discharge (HID) lamps, which are more expensive than traditional halogen headlights but more energy efficient.

Prices for an OEM headlight range from \$526 for the Subaru Legacy and Outback to about \$3,200 for the BMW 5 series.

This is the case for headlights that rate poor, too. For instance, a poor-rated halogen headlight on the Mercedes-Benz GLE-Class is \$615, an LED on the Honda Civic is \$826, and an HID on the Chevrolet Silverado is \$1,295.

Headlights consist of a molded plastic assembly that includes a housing, reflectors and a lens, and most are designed to fit just one model of vehicle. Even though bulbs or LED units and power modules can usually be replaced when they wear out, if any part is damaged the whole headlight generally must be replaced.

“Repair costs for a minor crash could easily double if a headlight is damaged,” says Sean O’Malley, senior test coordinator at IIHS. “Not to mention the extra time your car will spend in the shop getting fixed.”

The Institute’s experience with one automaker indicates that manufacturers have wiggle room when it comes to setting prices.

“When we did an initial survey of prices last year for 2018 models, Ford was charging \$4,555 for a Lincoln Continental headlight, the most expensive one in our survey,” O’Malley says. “We let Ford know the price was out of line with other manufacturers. This year that same headlight costs \$1,667.”

Expensive headlights aren’t a new issue. The Institute’s bumper test program has highlighted the problem since the 1990s. In tests of 2007 midsize luxury cars, for example, it cost \$847 to replace the HID headlight on the Infiniti G35 and \$1,046 for the one on the Lexus ES, not counting installation fees (see *Status Report*, August 4, 2007, at iihs.org).

Stronger bumpers could help protect not only headlights but also other front-end equipment, such as radar sensors and turbochargers. Reinforcement bars that extend far enough outward beyond the frame rails to protect the front corners of vehicles would help to limit damage to headlights in low-speed crashes. Bumpers that are taller and higher off the ground also would help. ■



Lincoln Continental

Prices for an OEM headlight

Vehicle	Cost	Vehicle	Cost
Subaru Legacy	\$526	Hyundai Elantra	\$1,348
Subaru Outback	\$526	Hyundai Sonata	\$1,365
Chevrolet Volt	\$540	Lexus NX	\$1,461
Kia Niro hybrid	\$792	Alfa Romeo Giulia	\$1,480
Mazda CX-5	\$804	Lexus RC	\$1,545
Subaru Crosstrek	\$860	Mercedes-Benz GLC	\$1,560
Kia Rio	\$883	Genesis G80	\$1,597
Hyundai Kona	\$910	Hyundai Santa Fe	\$1,642
Subaru Impreza	\$927	Genesis G90	\$1,658
Subaru WRX	\$927	Lincoln Continental	\$1,667
Kia Soul	\$1,027	Kia Forte	\$1,788
Mazda CX-5	\$1,085	Toyota Camry	\$1,810
Honda Ridgeline	\$1,134	Mercedes-Benz E-Class	\$2,580
Kia Sedona	\$1,167	Mercedes-Benz GLE-Class	\$2,820
Hyundai Santa Fe Sport	\$1,203	BMW X3	\$2,840
Lexus NX	\$1,213	BMW 5 series	\$3,242
Kia Optima	\$1,262		

All headlights on these 2018 models have poor ratings.

Audi Q3
Buick LaCrosse
Cadillac ATS
Cadillac CTS
Chevrolet Bolt
Chevrolet Colorado (crew)
Chevrolet Colorado (extended)
Chevrolet Impala
Chevrolet Malibu
Chevrolet Silverado 1500 (crew)
Chevrolet Silverado 1500 (extended)
Chrysler 300
Dodge Charger
Dodge Grand Caravan
Dodge Journey
Fiat 500X
Ford Edge
Ford Explorer
Ford F-150 (crew)
Ford F-150 (extended)

Some manufacturers are leaving drivers in the dark. Poor-rated headlights are the only ones available on 43 models IIHS evaluated.

Ford Fusion
Ford Taurus
GMC Canyon (crew)
GMC Canyon (extended)
GMC Terrain
Honda Civic (2-door)
Honda Civic (4-door sedan)
Honda Civic (4-door hatchback)
Honda Fit
Honda HR-V
Hyundai Accent
Infiniti QX60
Jeep Renegade
Kia Niro Plug-In Hybrid
Mercedes Benz C-Class
Mercedes-Benz CLA
Nissan Frontier (crew)
Nissan Frontier (extended)
Toyota 4Runner
Toyota C-HR
Toyota Yaris iA
Volkswagen Passat
Volkswagen Tiguan Limited

(« from p. 4) entertainment packages is a common industry practice that can add thousands of dollars to the price of a new vehicle.

The best available headlights on the Kia Soul, for instance, earn a good rating, but consumers must buy a \$3,000 or \$6,000 options package on one of the top two trim lines to get them. This pushes the small car's price to nearly \$26,000, compared with about \$16,000 for the base model and its poor-rated headlights.

Better aim and high-beam assist

Headlights are essential crash avoidance technology. About half of all fatal crashes in the U.S. occur in the dark, and more than a quarter occur on unlit roads. Headlights have an obvious role to play in preventing nighttime crashes, but not all headlights perform their job equally. Differences in light source, headlight technology and even something as simple as how the lights are aimed all affect the amount of useful light supplied. Properly aimed low beams light up the road ahead without temporarily blinding drivers of oncoming vehicles.

Subaru is among a handful of manufacturers that made running changes to certain 2018 models to improve ratings, mostly by readjusting headlight aim. As a result, the Crosstrek moved to a good rating from poor for its best-available headlights, the Forester climbed to acceptable from marginal, and the Outback rose to good from acceptable.

Other manufacturers that made similar running changes are Hyundai/Kia, Mazda, Mercedes-Benz, Volkswagen and Volvo.

In IIHS evaluations, engineers measure the reach of a vehicle's headlights as the vehicle travels straight and on curves. Each rating provides information on the amount of visibility provided by low beams and high beams and whether the glare produced for other drivers is excessive.

Low beams are weighted more heavily than high beams because they are used more often. IIHS weights the readings on the straightaway more heavily than those on the curves because crashes are more common on straight sections of road.

"Properly aimed headlights that are bright enough to illuminate the road but not enough to bother oncoming drivers can make nighttime driving less stressful — and help drivers avoid crashes," Aylor says. "Good headlights also improve the chances that attentive drivers will see pedestrians in time to slow down for them."

High-beam assist is quickly gaining traction — 45 percent of the 2018 models evaluated have the feature, up from 37 percent in 2017. High-beam assist automatically switches between high beams and low beams, depending on the presence of other vehicles. Research shows drivers rarely turn on their high beams. High-beam assist helps boost driver use of high beams. Vehicles with the feature get extra credit in IIHS headlight evaluations. ■



The 2018 Kia Sedona's HID-projector headlights are rated good. To get them, consumers need to buy the SX trim line equipped with the Advanced Touring package or the SXL trim line. The minivan's other trim lines have halogen projector headlights rated poor. These lamps produce excessive glare.

GM front crash prevention systems reduce police-reported crashes

An IIHS study of General Motors vehicles with optional front crash prevention systems adds to the evidence that forward collision warning and automatic emergency braking prevent crashes.

GM vehicles with autobrake and forward collision warning had 43 percent fewer police-reported front-to-rear crashes of all severities and 64 percent fewer front-to-rear crashes with injuries than the same vehicles without any front crash prevention technology.

For vehicles equipped with forward collision warning only, the crash rate reductions were 17 percent for all front-to-rear crashes and 30 percent for front-to-rear crashes with injuries.

The results echo an earlier IIHS study involving Acura, Fiat Chrysler, Honda, Mercedes-Benz, Subaru and Volvo vehicles, which found that the combination of forward collision warning and autobrake reduced front-to-rear crash rates by 50 percent for crashes of all severities and 56 percent for front-to-rear crashes with injuries. Forward collision warning without autobrake cut the rates 27 percent and 20 percent, respectively, for vehicles in that study.

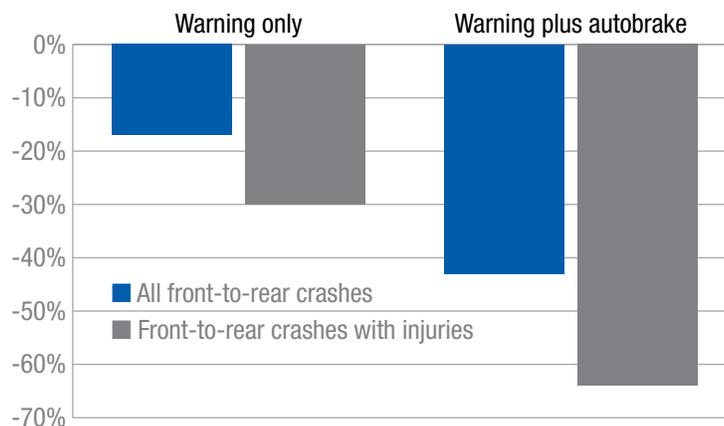
“The evidence has been mounting that front crash prevention works, and it works even better when it doesn’t solely rely on a response from the driver,” says Jessica Cicchino, IIHS vice president for research and author of both studies.

The new research involves 2013–15 Buick, Cadillac, Chevrolet and GMC brands. GM provided vehicle identification numbers (VINs) for vehicles with and without front crash and other crash avoidance systems.

Cicchino obtained information from 23 states on police-reported crashes involving those VINs. The police reports include information on the point of impact, allowing Cicchino to focus on front-to-rear crashes, which are the crashes that front crash prevention technology is designed to help avoid or mitigate. Using exposure data from HLDI, she calculated the rates of these crashes per insured vehicle year.



Differences in police-reported crash rates for GM models with front crash prevention vs. same models without



The IIHS study found safety benefits for GM vehicles equipped with forward collision warning only and even bigger benefits for vehicles also equipped with automatic emergency braking.

Information from HLDI’s database was used to control for factors that might have affected crash rates, including the vehicle’s garaging location and driver characteristics.

Cicchino used the information provided by GM on the presence of other crash avoidance features to control for advanced headlight

features, which could affect the likelihood of rear-ending another vehicle in the dark.

Twenty automakers representing more than 99 percent of the U.S. auto market have agreed to make automatic emergency braking standard on virtually all new passenger vehicles by September 2022. ■

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IIHS is an independent, nonprofit scientific and educational organization dedicated to reducing the losses — deaths, injuries and property damage — from motor vehicle crashes.

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.

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