



AUTOMOTIVE ENGINEERING

FACT SHEET



Test Results: Automotive Headlamp Systems

BACKGROUND & METHODOLOGY

Compared to early automobiles, modern headlamps bring substantially more light to night time driving. Each advancement in headlight technology has involved a compromise between providing enough light for drivers to see the road ahead and avoiding the light scatter or poorly aimed lighting that contributes to glare.

Vehicle lighting is critical because while only 25 percent of driving is done in darkness, 50 percent of crashes occur during those hours*. While many factors influence the rate of night time collisions, the performance of headlamps in lighting the roadway are the focus of this research.

AAA's testing was performed by engineers from the Automobile Club of Southern California's Automotive Research Center and the AAA National Office and is intended to provide an evaluation of advanced headlamp systems, an assessment of headlamp glare and guidance on the care and maintenance of headlamps. This testing included the use of calibrated light meters, Department of Transportation test methodology for automotive headlamp certification, as well human observation during various test scenarios.

KEY FINDINGS

- **Modern headlamp systems rarely contribute to disability glare due to the technology used to aim the light effectively. They can, however, contribute to discomfort glare, due to light color and size.**
- **Headlights operated on low beam provide enough illumination to perceive a non-reflective object at 300 feet (halogen reflector), 400 feet (halogen projector/HID) and 450 feet (LED).**
- **Based on AASHTO guidelines**, the lighting distance that low-beam settings provide is insufficient at speeds above 39 mph (halogen reflector), 45 mph (halogen projector/HID) and 52 mph (LED) when used on roadways without additional overhead lighting.**
- **High-beam headlights provide an average of 28 percent more forward illumination than low beams.**
- **On high beam, headlights provide adequate lighting for maximum speeds of 48 mph (halogen reflector) and 55 mph (halogen projector/HID/LED).**
- **Among those U.S. adults who drive at night, two-thirds (64 percent) say they do not regularly use their high-beam headlights.**
- **Restoration of halogen reflector headlamp lenses using consumer-grade products is effective. After lens restoration, maximum beam intensity was doubled.**
- **Lens restoration resulted in measurably less (60 percent reduction) glare-producing light scatter.**
- **One-in-five Americans report performing a headlight restoration service on their vehicle.**

To address headlight concerns, AAA pursued three lines of inquiry:

- 1. Are there specific types of automotive headlamp systems that are prone to creating glare?**
- 2. How much forward lighting is truly needed for safe night time driving?**
- 3. What can be done about deteriorated headlamps that have become yellowed or pitted?**



Based on averaged test results

AAA Test Results				
	LOW BEAM Lighted Distance	Max. Vehicle Speed*	HIGH BEAM Lighted Distance	Max. Vehicle Speed*
Halogen Reflector	300 feet	39 mph	400 feet	48 mph
Halogen Projector	400 feet	45 mph	500 feet	55 mph
High-Intensity Discharge (HID)	400 feet	45 mph	500 feet	55 mph
Light-Emitting Diode (LED)	450 feet	52 mph	500 feet	55 mph

**To ensure a fully-lit stopping sight distance. Calculations based on American Association of State Highway and Transportation Official (AASHTO) guidelines.*

AAA test results found that even with the most advanced headlight systems, the ability to see an object in the roadway at night is reduced by as much as 60 percent when compared to driving in daylight.

AAA RECOMMENDATIONS

When driving at night on unlit roadways, use high beams whenever possible. There is a difference between seeing the roadway markings, signs, and other vehicles, versus being able to perceive a non-reflective object in your path.

Monitor and adjust driving speeds when traveling on unlit roads at night to allow enough time to detect, react and stop the vehicle in order to avoid striking a pedestrian, animal or object in the roadway.

If your car’s headlamp lenses are anything but crystal clear, having them restored will provide a noticeable increase in visibility, and reduce glare for other drivers. If you like to work on your own car, this is a simple DIY project.

If you are age 60 or over and headlight glare is an issue, have your eyes checked by a medical professional. Cataracts that cloud the eye’s lens may be contributing to the problem.

ABOUT GLARE

- Glare is divided into two primary categories; disability and discomfort. Disability glare results in a measurable reduction in the driver’s ability to perform visual tasks and is often worse for older drivers. Discomfort glare is caused by situational illumination that is either too intense or variable. Discomfort glare is realized as an uncomfortable sensation for the driver and is a primary consideration for design and aiming of automotive headlamp systems.
- For HID and LED lights, the cooler/whiter light color that often comes from a smaller area can attract a driver’s attention because it differs in color and size from the headlamps of most other vehicles on the road. However, over time this tendency might decrease as the newer lighting technologies become more prevalent.
- According to Dr. Cynthia Owsley, Professor of Ophthalmology and director of the Clinical Research Unit at the University of Alabama at Birmingham School of Medicine, the most common cause of disability glare, especially in older adults, is reduced contrast sensitivity. The underlying cause of this age-related issue is increased opacity of the eye’s lens – eventually leading to cataracts—which starts for most people in their 40s and 50s.
- Poorly aligned headlamps continue to be a concern and contributor to discomfort glare. Proper alignment is of particular concern after a vehicle has been involved in a crash.