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Headlamp technology

By David A. Kolman, Editor

Headlamps are evolving to provide enhanced nighttime driver visibility

There have been a lot of advances in headlamp technology for commercial vehicles. While halogen bulbs and high-intensity discharge (HID) lamps are the most commonly used on heavy duty vehicles, LED (light emitting diode) headlamps are making inroads. Halogen headlamp systems offer competitive costing and industry standard performance. The main drawbacks of halogen is that they are not as efficient and have a relatively short life compared to some other options, such as LED lamps.

The drawbacks are accentuated in heavy duty applications where the operating environment is more severe than on cars, SUVs and light trucks.

Halogen lamps – basically a variation of an incandescent bulb – cost very little but typically have a short life, lasting only 500 to 1,900 hours, are fragile and their light output depreciates rapidly overtime. Lumen depreciation on

a halogen headlamp is as much as a 25 percent reduction in light output after just 100 hours.

Lumen depreciation is when the amount of light produced decreases and light color appearance shifts over time.

A halogen lamp has halogen gas sealed into a small envelope. This inert gas allows the evaporated tungsten from the filament to reattach the material



Vehicle headlamp technology has become increasingly more advanced, resulting in improved long-range visibility without causing discomfort, distraction and glare to the driver or others on the road.

Photo from iStock

VEHICLE HEADLAMP

technologies continue to evolve in form and function.

to the filament. This is called the halogen cycle.

Incandescent bulbs produce light using electricity to heat a metal filament until it becomes “white” hot or incandesces.

HID lamps – also known as xenon lamps because they contain a trace amount of xenon gas – provide much better illumination, are more energy efficient and last longer than a conventional incandescent headlamp – around 3,000 hours. HID lamps replace the filament within a

glass tube of gas. Light is produced from an electric discharge that forms between two electrodes.

HID lamps emit twice the light of halogen headlamps and produce a blue-white light.

To get the better illumination, HID lamps have to be paired with a ballast which is used to regulate the high voltage supplied to the capsule of gas. These lamps require special maintenance. It should be noted that potentially harmful materials are used in their construction.

LEDs

LED headlamps offer greater efficiency, less heat generation, better light color performance and much longer product life. They require very low power to work, are very durable and rugged and have lower cost over the life of the vehicle. A drawback of LEDs is that there is typically higher upfront costs.

LEDs produce light very efficiently by passing an electrical current through semiconductor material. LEDs are directional light sources, emitting light in a specific direction.

LED lamps typically do not “burn out” or fail. Rather, they experience lumen depreciation.

The lumen depreciation for LEDs is typically around a 7 percent reduction over 25,000 hours. It is not a major factor with LEDs, but in contrast, it is a major factor with halogen headlamps

LEDs will last up to 30,000 hours and they use a very low voltage. Truck-Lite introduced the world’s first LED custom headlamps for the commercial truck market in 2012.

LED headlamps provide a much better view for the driver because the light emitted is in a color spectrum that provides high contrast and is more readily seen by the eye. This results in a much safer view of the road and a generally longer range of illumination.

There is a perception that LED headlamps are brighter because the light LEDs produce is more of a true white color. Traditional halogen headlamps that drivers are familiar with have a yellow-white hue.

Industry experts describe the color of white that halogens produce as warm white. It contains a great deal of red, a small amount of green and very little blue. This helps a driver see stop signs, but they may not see other blue or green items.

MAINTENANCE

How involved is the maintenance and repair/replacement headlamps?

Halogen bulb replacements are very readily available, with well-established service methods. LED lamp assemblies are interchangeable, but the light sources or “bulbs” are not. LED bulbs are not legal for use in the U.S.

Trucks that use proprietary headlamps versus sealed beam bulbs generally require dealer service because, in general, there are no lamps per se, but the LEDs are integral to the headlamp system.

LED headlamps are designed to last the life of the vehicle, so they shouldn’t have to be replaced or repaired. There is no bulb and the solid-state nature of LEDs means that they are nearly impervious to damage from shock and vibration.

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Glare – defined as a bright light that interferes with vision – makes it difficult to see, plus is uncomfortable. This impacts a driver’s ability to properly see and that can make for a dangerous situation.

Photo courtesy of DK Communications

Headlamp coatings

Technological advances to the headlamps for commercial vehicles have resulted in longer headlamp life. That, obviously, is a good thing. But with it comes a serious problem that often isn’t given much attention: hazing, crazing/cracking and yellowing.

Regardless of the type of headlamp, they have highly engineered, optically-based light patterns that are specially aimed to give the driver the best view of the road ahead, as well as to prevent discomfort glare to on-coming drivers.

Today’s headlamps are made of hard plastic or polycarbonate resin, covered with a clear film (coating) to protect the surface. Over time, through exposure, this protective film wears away, resulting in hazing, crazing/cracking and yellowing on the headlamp.

These conditions negatively affect the headlamp by diffusing its light output for reduced visibility.

To lessen the effects of headlamp hazing, crazing/cracking and yellowing, properly clean headlamps on a regular basis.

COATINGS

There are many coatings available on the market today for headlamps. Make sure, as you consider specifying LED headlamps, that you get a coating that will last as long as the LED light sources.

The Technology & Maintenance Council (TMC) has a recommended practice – *RP 171, High-Performance Coatings for Forward Lighting on Commercial Trucks* – that provides guidelines for specifying coatings used on headlamps, fog lamps and driving lamps using plastic lenses that are used on commercial trucks. The intent is to increase headlamp service life, improve visibility and enhance safety.

TMC (www.trucking.org/Technology_Council.aspx) is the only industry association that is focused solely on truck technology and maintenance.

Contrary to some popular opinion, the headlamp restoration process does not return the lamp output to a like-new condition. The headlamps look better but do not produce the same output as a new headlamp.

Safety regulations

Included in the Federal Motor Carrier Safety Administration's safety regulations are requirements for vehicle lighting. These include:

- 49 CFR 571.108 - Standard No. 108; Lamps, reflective devices, and associated equipment. This standard specifies requirements for original and replacement lamps, reflective devices and associated equipment on passenger cars, multipurpose

passenger vehicles, trucks, buses, trailers (except pole trailers and trailer converter dollies) and motorcycles.

- 49 CFR 393.24 - Requirements for head lamps, auxiliary driving lamps and front fog lamps. Among other things, this regulation states that:
 - » Commercial motor vehicles may be equipped with auxiliary driving lamps and/or front fog

lamps for use in conjunction with, but not in lieu of, the required headlamps. Auxiliary driving lamps need to meet SAE Standard J581, Auxiliary Upper Beam Lamps, and front fog lamps need to meet SAE Standard J583, Front Fog Lamp.

- » Auxiliary driving lamps and front fog lamps shall be mounted so that the beams are

aimable and the mounting shall prevent the aim of the lighting device from being disturbed while the vehicle is operating on public roads.

- » Headlamps, auxiliary driving lamps and front fog lamps shall be aimed to meet the aiming specifications in 49 CFR 571.108, SAE J581 and SAE J583, respectively.

The initial install is very simple and, in nearly every case, the LED headlamps are backwards and forwards compatible. The halogen headlamp is removed and the LED lamp is installed in the same way.

Depending on the vehicle electronics, there may need to be a minor software change in some vehicles to accommodate light-out detection features on today's trucks.

Regardless of the type of headlamp, they need to be aimed properly. Headlamps pointed as little as one degree too high can make a big difference to oncoming drivers. Furthermore, misaimed beams do not cast as much light on the road.

Fleets should incorporate a regular preventive maintenance (PM) schedule to assure that vehicle headlamps are properly aimed.

All headlamps should be kept clean because even a thin layer of grime and dirt on the lens can block light output and degrade a driver's night visibility.



LED headlamps provide a better view for the driver because the light emitted is in a color spectrum which provides high contrast and is more readily seen by the eye. The left photo shows the illumination from halogen headlamps at low beam. The right photo shows LED headlamps at low beam.

Photo courtesy of Truck-Lite

NEXT?

An evolving vehicle headlamp technology for commercial trucks, as a way to improve visibility, is adaptive driving beam (ADB) headlamp systems. Basically, these are headlamps that adapt to the presence of opposing and preceding vehicles by automatically modifying portions of their beam pattern to reduce glare.

The objective is to improve long-range visibility for the driver without causing discomfort, distraction and glare to the driver or others on the road.

Europe and Japan have begun allowing ADB headlamp systems as optional equipment on select models. The National Highway Traffic Safety Administration (NHTSA) – which regulates automotive lighting, signaling and reflective devices in the U.S. – currently does not address this type of front lighting system.

However, NHTSA (www.nhtsa.gov) – an organization dedicated to achieving the highest standards of excellence in motor vehicle and highway safety – has been conducting research into adaptive driving beam headlamp systems both here and abroad.

SAE International (www.sae.org) – a global association of engineers and related technical experts in the aerospace, automotive and commercial vehicle industries – is working on a recommended practice – SAE J3069 – for test procedures, performance requirements and design guidelines for ADB systems and associated equipment. **FMX**

Contributing to this article were:

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Retroflective LED headlamp technology

A new LED headlamp with advanced retroflective LED technology engineered to emit a wider, brighter beam for increased visibility and safety, has been introduced by Optronics International. The Opti-Brite LED Headlamps also have a centralized LED cluster that enhances the lamp's appearance.

Optronics (www.optronicsinc.com) is a manufacturer and supplier of heavy duty LED vehicle lighting.

The new headlamps have a centralized lens element that houses rear-facing LEDs and a supplemental LED lamp array. The rear-oriented LEDs interact with precision-engineered metallic parabolic reflectors to create a beam pattern that "is ultra-bright, with broad, smooth photometric characteristics that approximate the color temperature of natural sunlight, improving visibility and reducing eye fatigue," company officials say.

The design is called retroflective because the LEDs producing the headlamp beam face backward, while the advanced reflector geometry does all the work of projecting the beam forward.

UPGRADES

The headlamps are designed to allow users to easily upgrade their headlamps from standard halogen and HID sealed beam to a higher-performing, longer-lasting LED light source.

Engineered to accommodate both 12V and 24V electrical systems, the lamps use standard H4 three-blade connectors.

It takes minutes to convert any vehicle with compatible headlamps to the new LED

technology, say the company officials. The lamps have an expected service life of 30,000 hours.

Like all LED products from Optronics, the new lamps come with its no-hassle, one-diode lifetime warran-

ty protection that will replace the lamp if even one diode fails.

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