

Road safety factsheet:

Vehicle lighting

July 2023

Introduction

Headlights were first introduced during the late 1880s. It is just as important to be able to see where you are going and for other road users to see you today as it was in the early days of motoring. Technology is evolving rapidly and this factsheet provides a summary of the main type of lighting currently in use and considers some of the issues associated with modern vehicle lighting.

The law

The [Highway Code rule 113](#) states that as a motorist you **must**:

- ensure all sidelights and rear registration plate lights are lit between sunset and sunrise
- use headlights at night, except on a road that has lit street lighting. These roads are generally restricted to a speed limit of 30 mph (48 km/h) unless otherwise specified
- use headlights when visibility is seriously reduced (see Rule 226).

Nighttime is defined as the period between half an hour after sunset and half an hour before sunrise.

[Rule 114](#) states that as a motorist, you **must not**:

- use any lights in a way which would dazzle or cause discomfort to other road users, including pedestrians, cyclists and horse riders
- use front or rear fog lights unless visibility is seriously reduced. You **MUST** switch them off when visibility improves to avoid dazzling other road users (see [Rule 226](#)).

In stationary queues of traffic, drivers should apply the parking brake and once the following traffic has stopped, take their foot off the footbrake to deactivate the vehicle brake lights. This will minimise the glare to road users behind until the traffic moves again.

Motorists should also (rule 115):

- use dipped headlights, or dim-dip if fitted, at night in built-up areas and in dull daytime weather
- keep headlights dipped when overtaking until level with the other vehicle and then change to main beam if necessary, unless this would dazzle oncoming road users
- slow down, and if necessary stop, if dazzled by oncoming headlights.

Technological advancements

In order to make vehicle lighting more efficient and to minimise the chances of the driver forgetting to switch on lights, manufacturers have been introducing new technologies that are designed to make vehicles safer and

Road safety factsheet: Vehicle lighting

reduce the likelihood of dazzle to oncoming drivers, pedestrians and cyclists. The main systems currently being offered either as standard or as an optional extra include:

Daytime Running Lights (DRL)

Vehicle manufacturers as of February 2011 must fit DRL to new types of passenger cars and light goods vehicles in accordance with European vehicle requirements, which means that many cars are now fitted with daytime running lights using LED technology. Similar requirements apply to HGV and buses. DRL are fitted to improve the visibility of the vehicle and as such need to be bright enough to ensure that they are visible in the daytime but not so bright that they will dazzle other road users, hence they must not be used at night.

DRL activate automatically when the engine is switched on and remain on unless the headlamps are switched on. As they work independently from the rear lights this means that drivers must switch on their normal headlights in poor visibility (including tunnels) as the vehicle will remain unlit from behind.

Research has shown that DRL are likely to reduce multiple vehicle daytime accidents and fatalities by up to 6 per cent once all vehicles are equipped¹. Therefore, if used correctly, DRL could potentially reduce the number of crashes and/or the severity of crashes by enabling drivers, motorcycle riders, pedestrians and cyclists to see oncoming vehicles sooner and react earlier to attempt to avoid a crash or begin braking sooner and thus reduce the crash severity². In contrast, a 2008 study by the National Highway Traffic Safety Administration³ concluded that DRL offered no statistically significant reduction in the frequency or severity of the collisions studied (frontal and side on crashes between two vehicles nor on vehicle collisions with pedestrians, cyclists and motorcyclists), except for a reduction in light trucks and van involvement in two vehicle crashes by a statistically significant 5.7 per cent.

Automated lights

Automated lights switch on headlights and rear lights in the dark or low light levels (e.g., in a tunnel or multi story car park), but only if the light switch is set in the automatic position.

Adaptive front lighting systems (AFLS)

These direct the headlight beams to the direction of travel, based on the angle of the steering wheel.

Advanced adaptive front lighting systems (AFLS)

These systems allow the headlights to boost visibility through bends; some also adjust the light pattern for different road speeds and visibility (e.g., narrower beam on motorways), a wider angle when turning corners (especially at junctions), and auto high beam that automatically switches high beam lights on and off to improve vision, but avoid dazzling on coming drivers.

¹ Department of Transport (2010) Daytime Running Lights: Information Sheet

² Symmonds (2009) ATRF 2009: 32nd Australasian Transport Research Forum: the growth engine: interconnecting transport performance, the economy and the environment: 29 September-1 October 2009, Auckland, New Zealand. 9

³ National Highway Transport Safety Administration (2008), The Effectiveness of daytime running lights for passenger vehicles: <https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/811029> - accessed July 2023

Road safety factsheet: Vehicle lighting

Main types of light source

There are two main types of headlight systems used in mass car production: halogen and xenon, together with the recent introduction of LED lights. Vehicle lights, including replacement lights if the originals fail, must conform to vehicle lighting regulations (see below) be correctly aligned.

Halogen - A halogen bulb produces a bright, white light and has a lifetime of about 1,000 hours.

Xenon - Xenon headlights, officially known as high-intensity discharge headlamps (HIDs), emit a clean white light. Xenon headlights are regarded as being much more efficient than halogen when it comes to the amount of produced light, although this can be a major issue in relation to dazzle if the angle of illumination isn't properly configured. A xenon bulb should last for about 2000 hours.

LED (Light Emitting Diode) - LED is a popular display and lighting technology that is used in various kinds of electrical and electronic products and is now increasingly used in vehicle lighting systems. The bulb has an extremely long life, whilst also requiring less electricity than the traditional halogen bulb. LED provides focused rays and can be manufactured to create different shapes, such as rear brake light clusters.

Lighting regulations

To ensure that vehicle lighting is fit for purpose, all components must conform to both UK and European regulations. The lighting system fitted to a modern European vehicle must comply with the requirements of the type approval process. Representative vehicles are assessed and vehicle manufacturers are required to ensure that the mass-produced vehicles match the specification of the tested vehicle. Compliance with the required standards is verified before a vehicle can be registered in the UK.

The assessment process is witnessed by an independent approval authority who oversee the testing, certification and production conformity in line with regulatory requirements. The authority is appointed by respective Member States and an approval issued by one Authority will be accepted in all the Member States. The Vehicle Certification Agency (VCA) is the designated UK Approval Authority for all type approvals to automotive EC Directives and most UN Regulations.

In terms of vehicle lighting, the individual lamps are assessed as components to ensure that they meet the required colour, intensity and light distribution. Subsequently, the installation of the lamps in the vehicle is also assessed to ensure that the component approvals are valid, the required number is fitted in the correct position and that they meet the required angles of visibility.

The vehicle lighting regulations for vehicles sold in Europe are developed at the United Nations in Geneva. The harmonisation of standards in this way allows vehicles to be sold without restrictions and ensure that vehicles are compatible across borders. The [Road Vehicles Lighting Regulations 1989 \(Statutory Instrument 1989, No. 1796\)](#), as amended governs the lighting of all vehicles used on the roads of the United Kingdom.

Glare and dazzle

In 2021, “dazzling headlights” was assigned as a contributory factor in 230 collisions. In these collisions, three people were killed, 73 were seriously injured and 214 were slightly injured⁴.

RoSPA is often contacted by members of the public who are concerned about oncoming vehicle headlights dazzling them. There is obviously a need for drivers to have good forward visibility without dazzling other drivers, riders or pedestrians.

A survey conducted by the RAC⁵ has found that most drivers (88 per cent) have been dazzled while driving, this figure is up from 60 per cent when the RAC conducted a similar survey in 2019⁶. There are several causes of dazzling headlights, for example if the headlights are misaligned (this is one of the parts of an MOT test that is very likely to be assessed incorrectly), or if the headlights have not been adjusted correctly to match the load the vehicle is carrying. The RAC recommends that drivers who experience dazzling regularly talk to their optician to get a pair of glasses with an anti-dazzle coating, adjust their rear-view mirror often and, when buying a new car, try to find one with a self-dimming rear-view mirror. Another helpful tip is to ask to have the aim of your headlights checked at your next service.

Higher intensity headlights offer better illumination during night-time driving which could be associated with casualty savings. However, glare can detract from optimal observation and hence vulnerable road users and other obstacles could be detected later or not at all.

Glare can cause discomfort or disability. Discomfort glare is described as not impairing to vision; however, it can be startling or distracting to a driver. It can also lead to blinking, squinting and fatigue. On the other hand, disability glare does impair visual performance. The De Boer 9 point lighting rating is a way of measuring the effect of glare on the individual, from unnoticeable to unbearable. Theeuwes⁷ found that car drivers may frequently experience blinding because of glare from oncoming cars when driving at night on a dark road.

Research by Mainster and Timberlak⁸ indicates that older individuals have increased glare sensitivity, and longer photostress recovery time. Therefore, brighter light sources are likely to present greater potential problems associated for older than for younger drivers.

⁴ Department for Transport (2022) Table RAS0701: Factors contributing to collisions and casualties: Collisions, casualties and road user types. <https://www.gov.uk/government/statistical-data-sets/reported-road-accidents-vehicles-and-casualties-tables-for-great-britain#vehicles-and-drivers-ras05> – accessed July 2023

⁵ RAC media centre (2022), Blinded by the lights - <https://www.rac.co.uk/drive/news/motoring-news/nearly-one-in-four-drivers-think-most-car-headlights-are-too-bright/#:~:text=What%20can%20I%20do%20if,go%20cut%20down%20on%20glare> – accessed July 2023

⁶ RAC Media Centre. Drivers who suffer glare from headlights say the problem is getting worse. <https://media.rac.co.uk/pressreleases/drivers-who-suffer-glare-from-headlights-say-the-problem-is-getting-worse-2884337>. Updated: June 11, 2019. Accessed: September 24, 2019.

⁷ Theeuwes, Alferdinck, Perel (2002) Relation between glare and driving performance

⁸ Mainster and Timberlake (2003) Why HID head lighting bothers older drivers.

Headlight adjustment

A fully laden vehicle can affect the angle at which the headlamps shine, the result being that the lights shine into the eyes driver of an oncoming vehicle or the car in front. In most vehicles, there is an option within the dashboard controls to adjust the angle of the headlight beam. It is also possible to adjust the angle of the beam by making manual adjustments with a screwdriver to move the beam either up or down. However, this should only be carried out by a competent person who is familiar with the procedure.

To check the alignment of headlights, park by a garage door or wall on flat ground and adjust the knob in accordance with the manufacturer's handbook; the height of the beam will change and will give a rough indication of the adjustment made. Remember to readjust once the heavy load is removed from the vehicle.

Illegal use of non-factory fitted equipment

Only type-approved lighting systems can be sold legally in the EU under the UN 1965 Vehicle Regulations. It is possible to purchase HID conversion kits, however, it is not legal to sell or use aftermarket HID lighting kits, for converting conventional Halogen headlamps to HID Xenon⁹. A person who converts their vehicle to Xenon HID must purchase completely new Xenon HID headlamps. The reason for this is that the existing lens and reflector are designed around a Halogen filament bulb, working to very precise tolerances. If one places a HID "burner" (bulb) in the headlamp, the beam pattern will not be correct, there will be glare in some places and not enough light in other places within the beam pattern.

Illegal use of fog lights

Fog lights should not be used in good visibility; they have not been designed for daytime running.

Rule 236 of the Highway Code states that:

- You **MUST NOT** use front or rear fog lights unless visibility is seriously reduced (see rule 226) as they dazzle other road users and can obscure your brake lights. You **MUST** switch them off when visibility improves

Rule 226:

- You **MUST** use headlights when visibility is seriously reduced, generally when you cannot see for more than 100 metres (328 feet). You may also use front or rear fog lights but you **MUST** switch them off when visibility improves (rule 236)

Technology will undoubtedly minimise the incidence of dazzle with the introduction of advanced adaptive front lighting systems, however, in the meantime drivers and riders who use high intensity lights MUST ensure that lights are correctly adjusted and they adhere to [rule 115 of the Highway Code](#)

⁹ DfT & DVSA (2010) Guidance: Aftermarket HID Headlamps, <https://www.gov.uk/government/publications/aftermarket-hid-headlamps/aftermarket-hid-headlamps#the-legal-situation> – accessed July 2023