A Light's Not Just For Christmas

When darkness descends what we look for is a light to shine down and show us the way. Christmas, or even Diwali and Hannukkah for that matter, are all festivals of light in one way or another, about the importance of seeing clearly and understanding; going forward guided by the light of truth. So it seems a rather appropriate time to look into what some drivers are describing as the 'lightmare' on our roads today, whilst others are calling it one of the most important developments in improving drivers' night time vision and, therefore, road safety.

Car lights have certainly come a long way from the candle and oil lamps used on the first motorcars over 100 years ago. However, the speed of progress in the last decade has taken the humble headlight into new realms of power and efficiency through the arrival of Xenon and LED systems. In this article we want to look at the on-going debate over the increasingly popular Xenon lights, which use a micro-discharge bulb full of noble gases, of course including Xenon, and are unlike normal incandescent bulbs in that they do not have any filaments. Instead, these bulbs light up when an electrical current forms an arc between two electrodes of tungsten metal. Also called High Intensity Discharge lamps (HID), Xenon light also comes with an electronic starter and a ballast to start up and maintain this arc, and the resulting light. The ballast is also important as it manages the energy levels, and automatically shuts off when voltage threatens to escalate beyond acceptable levels, so preventing the bulb from exploding. It certainly sounds quite a volatile formula, and that volatility is spreading to the reactions of motorists all over the world.

I'm sure you have all come across plenty of approaching cars at night that you thought were failing to dip their headlights, or had failed to get their headlights adjusted properly, probably after a knock of some sort. In fact, it was probably just a car with Xenon lights installed instead of the regular halogen light bulbs of the past. This trend towards HID lights has grown exponentially over the past few years - once a luxury of the high end car market, they're now a popular feature through the ranks, as well as being an easy after sales upgrade. It seems now that almost every other car on the road has a pair of bright blue / purple tinted lights, a trade mark appearance of Xenon lights because of the spectrum of light that they utilise. This growing popularity is based on a simple premise that the more light your car is capable of emitting onto the road ahead, the more you will be able to see and the safer you will be. This is a feature that is certainly being realised by manufacturers as yet another great 'safety feature' selling point, as is the bluish tint of the super bright lights (in fact, traditional halogen bulbs are being painted blue to cash in on this fashion!)

Xenon light bulbs certainly have greater output of light - they are up to three times brighter than standard halogens. At night this is very crucial because lack of visibility (or perceived lack of visibility) is regarded as the biggest cause of automobile accidents during night time driving. Secondly, the viewing radius provided by these bulbs is increased by up to 70% (or 100% according to claims by Ring for their latest set of Xenon lights), which helps illuminate any blind spots on the road, especially useful in spotting any potential road-side hazards such as debris, animals or even pedestrians. The whiter light with its blue tint is promoted by some camps, including manufacturers, as actually sharpening and improving our vision on the road, by penetrating the darkness and tougher weather conditions more effectively. However,

others, including members of the medical and ophthalmic professions, disagree, stating that the blue light actually causes greater levels of glare, making the eyes 'shortsighted' due to chromatic aberrations at the centre of the retina which recognise blue. In fact, the yellowish light produced by the traditional halogen lights actually improve the contrast visibility of the eye by reducing the 'blue blur' on the road from the surface objects, which distract the eyes' focus.
But one benefit of Xenon bulbs that is not disputed is that they are more user and environmentally friendly. This is essentially because they are far more durable than their Halogen counterparts, withstanding greater amounts of vibration and shock from the road because there is no filament, increasing the bulbs' lifespan. Xenon gas will last up to 10 years; this is three times longer than the standard halogen bulb. And whilst you may think that being three times brighter will require three times the power supply, Xenon bulbs actually consume 25% less power than standard headlights.

The softer light from Halogen compared to Xenon headlights, though Xenon provides a better vision for the driver.

Xenon projector low beam headlamp.

The Glaringly Obvious
So you would think that the road ahead looks good, but that's not necessarily the case if you are facing a wall of light from an oncoming car that's actually blinding in effect. Personally, I often find myself struggling to see past the glare of modern ultra-bright white headlights, or being blinded momentarily by the expensive Bi-Xenon lights that seem to concentrate an even more powerful beam, which acts like laser surgery on the retina every time the approaching vehicle hits a bump or comes over the crest of a hill. And it's not just me that seems to be suffering the effects of brighter night sights; it seems to be a popular topic of debate across all ages and sections of society, backed up by doctor and optician case notes. The question has to be asked: Are these brighter lights actually making night-time driving safer?
Most people like to describe the problem as one of excessive 'glare' (disability glare being a principle area of concern - the retina is effectively knocked out, temporarily creating the sense of looking through a dark tunnel, and the older we get, the longer our retinal recovery time following 'light stress'). However, it might not be as simple as a 'glare' issue.
First of all, we need to understand a few technical properties of light. The purpose of a lamp is to convert electrical energy into luminous flux (light), which itself is quantified by the term lumens. We can't see raw lumens, in fact we cannot actually see light until it interacts with a surface or material, and then what we see is light reflected, transmitted or generated by the surface. In the case of a bare lamp what we see is the filament, plasma, or the lamp envelope. The light we actually see is known as luminance (brightness) which is the luminous intensity per projected area off a surface - this is quantified with the unit of the footlambert, which is a directionally dependent unit. As the direction of view changes, so can/does the luminance of a surface. Everyone has experienced this with a glossy magazine and a down light; there is an angle between the light source and the magazine that makes it very difficult to see the page because it is too luminous (bright), but if you tilt the magazine, effectively changing the viewing angle, the page becomes visible.
The technical definition of glare implies very high contrast between the light source and the background (overstraining the optical system beyond its physical limits). So, there would seem to be two ways to control glare: firstly, by decreasing the luminance (brightness) and reducing the amount of blue in the spectrum of the source; or, secondly, increasing the luminance (brightness) of the background. As an example, consider the glare from headlights during the daytime versus the glare from the same headlights on an unlit street at night (though there are some who would argue that, especially for the elderly, similar problems can result from the use of HID daylight running lights, but that's another topic for another time).

It's The Law
When it comes to the law and the headlight itself, the Ministry of Transport Test (MOT) is made up from various regulations, including the Construction and Use Regulations 1986 (CUR1986), and the Road Vehicle Lighting Regulations 1989 (RVLR 1989). The CUR mentions that any lights fitted to a vehicle must actually be in working order, and the RVLR stipulate the angle and the colour. The RVLR, however, makes no mention of intensity of the light emitted from the headlights, but Schedule 4, Part 1, Section 4 of RVLR 1989, states: 'lights must not be set to dazzle on-coming drivers'. This means that a headlight is restricted not by direct power, but the amount of light generated above horizontal (height and angle of dipped beam) so as not to dazzle oncoming drivers, so a xenon headlight can produce no more luminous intensity above horizontal than can a halogen headlight. If we assume the area of a headlight reflector system is equal regardless of the source, then the luminance of a headlight viewed from above horizontal can be no higher with a xenon source than a halogen source. Thus the 'glare' from a xenon system cannot be higher than the glare from a halogen system. 'Where are all those extra lumens produced by a xenon lamp?' you might ask. The headlight reflector system directs them below horizontal, where they will be useful in lighting the roadway surface.
But this is not a failsafe protection according to specialists. The new HID light sources have been condensed in size compared to the traditionally larger headlights of the past, intensifying the light source into a distinct point of light, and described as 'isotropic' - the intensity means

that the point of the source of light is equally intense from all directions, even if the intended beam of light is itself directed below the horizontal. On top of this, the intense spot of light can cause some drivers to stare at the light source unconsciously, almost as if hypnotised, adding to the blinding problems.
We know a Xenon headlight is much more luminous than a Halogen system when viewed from below horizontal. This, then, explains why lorries, vans and 4x4/SUV headlights appear much brighter when viewed from an on-coming vehicle, or from a vehicle in front - the horizontal plane passing through the truck headlights is higher than your eyes when seated in a car, thus you are viewing the unrestricted luminous intensity zone below horizontal. This is when the sheer intensity of the Xenon lights can seem blinding compared to Halogen headlights, which can be bad enough. So, mathematically or technically speaking, Xenon headlights cannot be more 'glary' than Halogen, but when your eyes are caught in the direct beam, for whatever reason, their brightness is more intense. This is also partly due to the spectral power distribution of the source - short wavelengths (blue) of light are more energetic than longer wavelengths (red), and ultraviolet light can be much more damaging to pigment and tissue than infrared light.

Night Owls

One person who definitely believes that Xenon lights have a dark side is London cabby Ken Perham. So disturbed by the technological advance, Ken and fellow sufferer Howard Redwood have set up an on-line petition which they hope will force Parliament and, more to the point, the government, to investigate what they regard as a seriously dangerous problem. Ken has been driving taxis solely at night for the past 36 years, so takes an authoritative seat in this debate. It is over the last five years that he believes the problem has really got out of hand. 'I was getting regularly blinded by my own fellow Taxi Drivers! It took me a couple of weeks to ask twenty Taxi Drivers, all blinding me in my rear view mirror, what their headlamp scroll switch was set on. I think it was only one or two who had any idea that there was a switch to adjust headlights when carrying heavy loads. I was totally shocked by this - I expected all drivers be aware of such an important switch at night, especially professional drivers. I eventually asked five hundred, of which only sixty were aware of it and, sadly, only twenty were capable of using it properly.'

Do you know where yours is, and do your students?

Of course, the volume of traffic on the roads during the hours of darkness is lower than during the day, but road safety statistics reveal the frightening fact that around 40% of road traffic accidents occur during this period of the day. Breaking this down, it is difficult to ascertain the reasons behind this high incident rate, though various studies on sleep deprivation made by Professor Horne at Loughborough University and the Transport Research Laboratory (TRL) suggest that 16% of crashes are sleep deprivation orientated, leaving 24% associated with a whole range of other factors. Of course, decreased visibility is going to be a significant factor at night, especially if you are effectively blinded by other vehicles' headlights.
Driving at night on a single-carriageway road, with no form of 'uniform' lighting, our eyes are constantly having to adjust to the street lamps (one intensity) above us, the tail lights of other vehicles (another intensity, and another that has increased dramatically with the incorporation of high mounted added brake lights on most vehicles) in front of us, and then the variable intensity of on-coming vehicles' headlights. This becomes all the more difficult for the brain to assimilate when there are wet conditions, because we have to deal with the secondary light of glare and reflections coming off the wet road surface, as well as diffused light from the rain on our windows and windscreen. Then the whole problem can be further exacerbated by dirty or steamed up windscreens.
The eye has to work very hard to constantly adjust to the variable lighting levels, and the brighter the light it confronts, the higher the contrast and the greater the chance that it will mask other less well lit objects in either the foreground or background. These may well be cyclists and obstructions, or even the edge of the road itself - spacial awareness becomes another victim of the lighting war.
Light intensity is really the name of the potential enemy. For example, a cyclist with lights should be seen because he is lit, but only if the lights are brighter than the surrounding ambient light. If you put a car with bright headlights behind, then the cyclist's lights lack the contrast to show up.
Of course, these problems are inherent with night-time driving, but the increased intensity and brightness of vehicle headlights appear to be making this problem even more dangerous. In fact, Mario Motta, president of the Massachusetts Medical Society, has joined a chorus of concern by stating that problems caused by bad lighting are a public health hazard, especially the older you become. Such damage can include opacities in the eye's lens and vitreous body, light damaged retinae, degenerative changes, retinopathies etc.
Glare light scattering in the eye causes loss of contrast - visibility, conspicuity and consciousness - and leads to unsafe driving conditions. In essence, bright and /or badly shielded lights may partially blind drivers or pedestrians and contribute to crashes. American comment and blog sites have been publishing numerous complaints about Xenon lights for over a decade.

Whose Lights Are They Anyway?

Of course, manufacturers are now battling to outperform rivals in the lighting stakes, using this as yet another selling tool, and claiming increased performance on safety grounds. But we cannot really blame the manufacturers when, to compete, they have to work within the rules set by government. Unfortunately, the rules and regulations laid down by Parliament have not been amended or revised to cope with any problems arising from a wholesale change in the form of lighting, and the serious increase in the power of headlights - a potentially serious road safety issue.
Before the advent of EuroNCAP forced manufacturers to use safety as a selling point for the cars they were manufacturing (to reverse the bad publicity caused by the publishing of poor crash test results), the same was true of the cars themselves - the manufacturers have been forced, through public purchasing pressure, to incorporate greater passenger protection into their vehicle

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designs, saving many deaths and serious injuries in crashes. Ironically, these safety changes have also had a detrimental effect on the issue of headlight glare - cars have got bigger as more safety features are incorporated. This, combined with the trend for the larger 4x4 style of vehicles, has meant that headlights are positioned higher from the road. Though there are the regulations set out in RVLR 198 as previously discussed, you cannot avoid the fact that the higher the lights within the degree of angle, the further the hypotenuse (the furthest point where the lights meet the ground - Pythagoras' Theorem), and the earlier the beam will strike the on-coming traffic. As the distance between the two vehicles decreases, the on-coming lights get higher and more intense. If you add the effect of heavy loading in the rear of the vehicle, the angle of lights changes; this is why a 'scroll' switch is fitted to most vehicles, though it appears that it rarely gets used in practice - education or laziness?
Perhaps this type of adjustment should be a required, automatic feature on new cars. With Bi-Xenon headlights generally found on the higher end of the car market, lights are automatically self-levelling, according to vehicle load or road conditions. However, this is not a new idea - the Citroen DS in the '60s and '70s employed self-levelling as well as swivelling headlights, and though highly regarded, nobody followed suit until the '00s! This goes some way to showing that, without compulsion through legislation or negative public exposure, nothing really changes.

Legal Review

Ken Pernham provides another good example of how the issue is being knowingly ignored by many manufacturers. 'A purchaser of a new luxury 4x4 heard about my campaign, and retold his experience when buying his new car. The salesman explained that the car came with the Bi-Xenon headlights, a much more effective lighting system. He then said to the customer that 'you must be very careful when you pick up your new car and drive at night, as lots of other drivers will flash you because your lights are so bright. In fact, they are 30% brighter! But, don't worry, your vehicle passes all the government tests'. Ken continues: 'This is tantamount to actually admitting the lights are dangerous to others. I've spoken to hundreds of people and about 75% agreed that there appears to be a problem with this new type of headlight. What happens if the government does nothing?

Citroen designed and implemented directional and self-levelling headlights way back when.

The Season Of Goodwill To All Men

Ignorance has a large part to play in what is becoming a lighting war. As drivers find it more difficult to see past the headlights of on-coming vehicles, they believe that the way forward is to improve the brightness of their own vehicles' headlights, but often without the appropriate adjustment or adherence to regulations, and so the problem escalates and literally becomes a case of the blind leading the blind.'
Of course, brighter lights, especially a type of light that gives a clear view of the road ahead, are a positive thing in the realms of road safety, but the light intensity also has its drawbacks and surely these need to be investigated and addressed to ensure that we are not talking one step forward whilst taking two steps back.
This is the reasoning behind Ken and Howard's decision to raise a Number 10 on-line petition through their website www.blindedbixenon.co.uk, encouraging the government to revise its laws and guidelines concerning headlights in view of the modern developments.
As well as calling for new regulations and testing that is more appropriate for the intense brightness of the Bi-Xenon headlamp, he is calling for a small addition to the Driving Test that takes into account driving at night, including advice and education on the headlamp scroll switch.
'It is a simple invention brought in to prevent drivers from blinding others that appears to have been missed by most drivers,' states Ken. '90% of drivers do not know they have one of these switches and, even if they do, they cannot use it properly; most drivers think that zero is the low setting (for heavy loads) when, in fact, the higher the setting number, the lower the light beam.
'I have questioned over 2,000 drivers on the Headlamp Scroll Switch and very few can tell you if they even have one. Worst of all, I actually spoke to one police officer who politely asked me to show him how the switch worked - he had no idea his vehicle had one! Ignorance is no excuse in the eyes of the law, and should not be an excuse for the law makers and enforcers either.'
Light is an essential part of our lives, whether physically or spiritually. As with anything that has such powerful potential, it needs to be used with care and consideration to prevent us from being blinded by the possibilities that may prevent us from seeing any potentially darker consequences.

Petition?

If you believe the government should investigate this issue, and possibly revise the laws and guidelines around the use and design of vehicle headlights, please sign the on-line petition by going to: www.blindedbixenon.co.uk.

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