Innovative Vehicle Lighting Beyond 2000

One hundred years of development have turned the motor car into a commodity of today's mobile society. Growing awareness for safety, increased regulation of traffic and modern state of the art monitoring and enforcement equipment have led to a relative reduction in accident fatalities.

International studies however show that the proportion of night-time to day-time accidents has not altered. Many accidents actually occur at low speeds with lack of visibility or obscured vision. Overseas studies show that accident risks double on night drives and rise further in adverse weather conditions. Night-time accidents are more severe, overseas studies show that on driven kilometer comparison, fatal accidents are twice as likely after darkness or in twilight.

The introduction of passive safety features such as crash barriers, seat restraints or airbags has reduced the overall number of severe injuries. It has not affected the relative risk of night- time accidents.

A recent study on night driving in Europe revealed that woman often feel uncomfortable due to insufficient visibility and that many men realize they would not be able to avoid an unexpected obstacle.

Vision provides 90 % of all driving information relevant for safe driving. Vehicle lighting plays a major role in active safety. The introduction of halogen light sources, the arrival of projector headlamps, the innovation towards highly efficient free-form headlamps and the recent move towards high-intensity discharge lighting increase the available light output and thus permitted the light distribution to be tailored to the prevailing driving and road conditions.

Fast light sources for signal lighting, such as LED and NEON, in brake lights have allowed faster warning and reaction times for drivers of following vehicles, reducing the available braking distance significantly.

Quality of Front Lighting can prevent accidents

Good lighting can also increase visual comfort. For example, today's free-form surface headlights can control the beam to illuminate road markings and verges for additional visual guidance.

In future more and more cars will be equipped with high intensity gas discharge lighting (Xenon), dynamic self leveling headlamps and automatic lens cleaning devices. All these features are today already standard equipment on some of the up-market European vehicles.

The modern headlamp module will show less glare for oncoming traffic whilst at the same time produce a steady and reliable field of vision. Studies underway for the Advanced Front Lighting System (AFS) sets out to increase visual performance for varying road or weather situation by taking into account the comfort requirements of driver and traffic.

Main points and safety considerations of modern headlamp technology

- Advances in headlamp design and light source provide more than 500 % improvement over conventional sealed beam units .
- Brighter headlamps need more accurate adjustment and the use of precision replacement bulbs.
- Brighter is safer only applies for accurately maintained systems.
- Brighter and mis-adjusted is more dangerous than bad lighting.
- Xenon discharge bulbs have 2.5 times the luminous flux of conventional H4 QH bulbs
- In Europe Xenon discharge headlamp systems will in future only be legal if used with automatic headlamp leveling systems. A mis-adjusted Xenon discharge headlamp significantly endangers oncoming drivers.
- New Zealand will have a mix of the oldest, least efficient sealed beam headlamps and the latest and brightest in Xenon gas discharge headlamp design. This is a major safety concern if the lighting is not properly maintained.

Improved Rear Lighting and Signaling

Vehicle lighting provides vision and visibility. A current trial in Europe evaluates alternatives for improved conspicuity of heavy- goods vehicles at night. Contour markings and area highlights on the vehicle prove to be more effective than point light-sources for immediate identification.

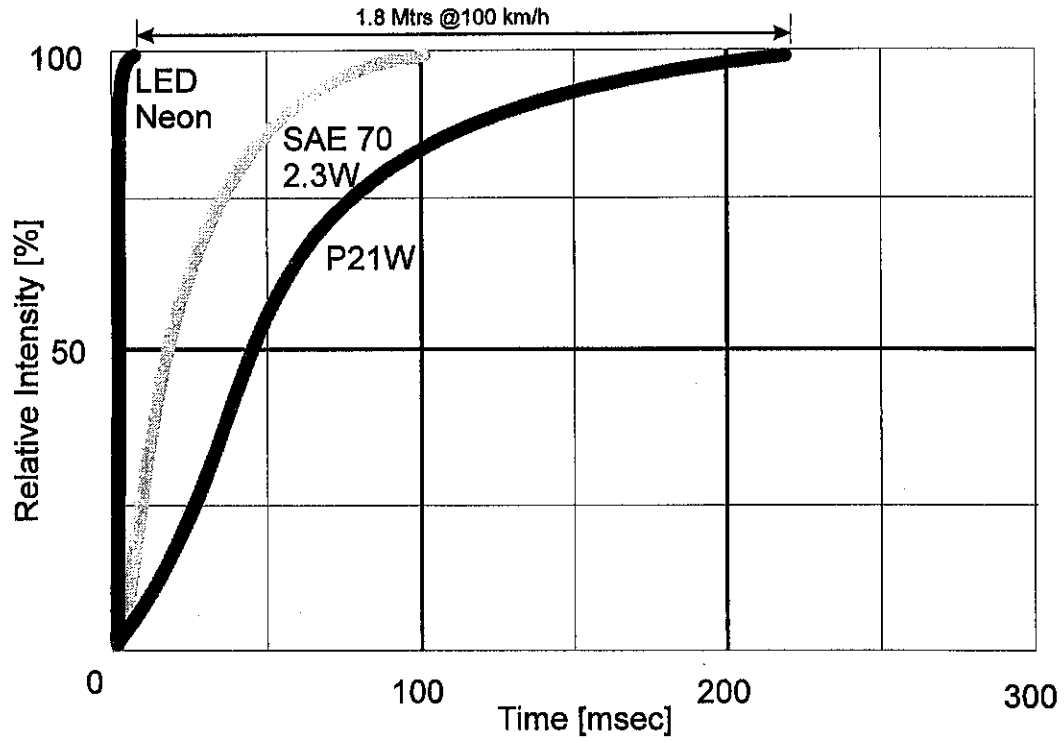
The significant reduction in side and rear end accidents involving marked heavy goods vehicles has led to changes in the regulations. Similar effects can be expected for smaller vehicles.

Reliability, low-energy consumption and rapid response are performance features which apply also to signal lighting for vehicles. New light-sources such as LED or NEON provide service lives in excess of vehicle life, reduced power consumption of up to 70 % and shorter ramp- up time.

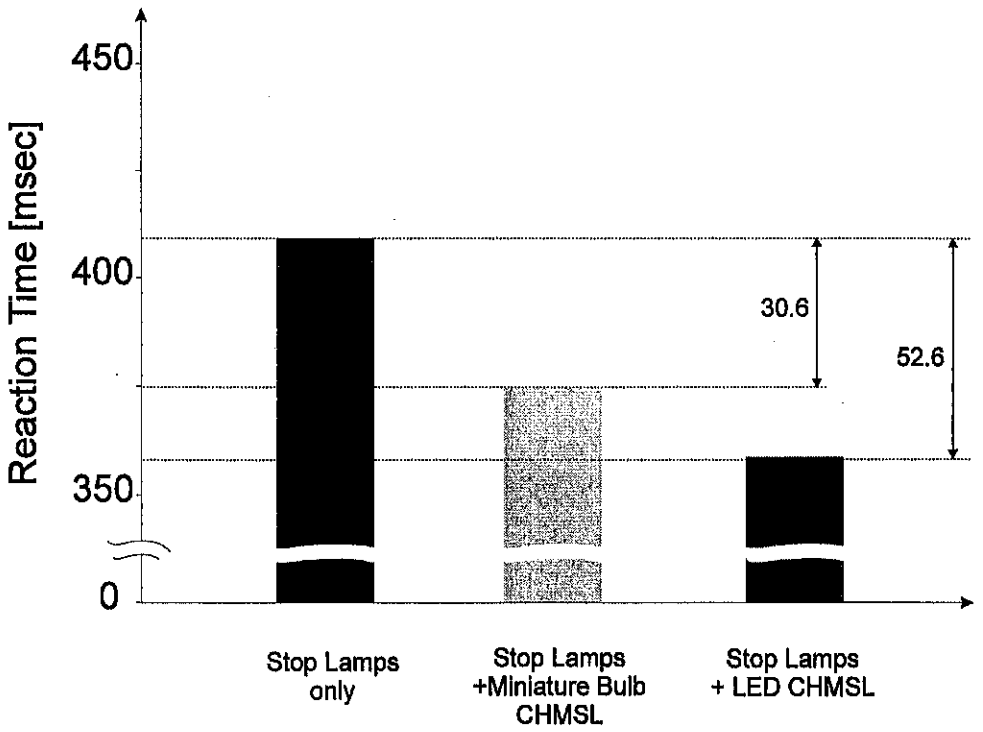
For a brake light, the speed of LED or NEON is significantly better than incandescent and can shorten the braking distance of following vehicles by over a meter.

LEDs light up very fast, almost instantaneously. The chart below shows the rise time of an LED lamp compared to a miniature bulb and a standard 21 watt incandescent bulb. For a stop lamp this translates to added warning time and safety braking distance.

RESPONSE TIME OF INCANDESCENT BULBS AND LEDS



REACTION TIME COMPARISON



Design considerations for lamps utilizing LED technology

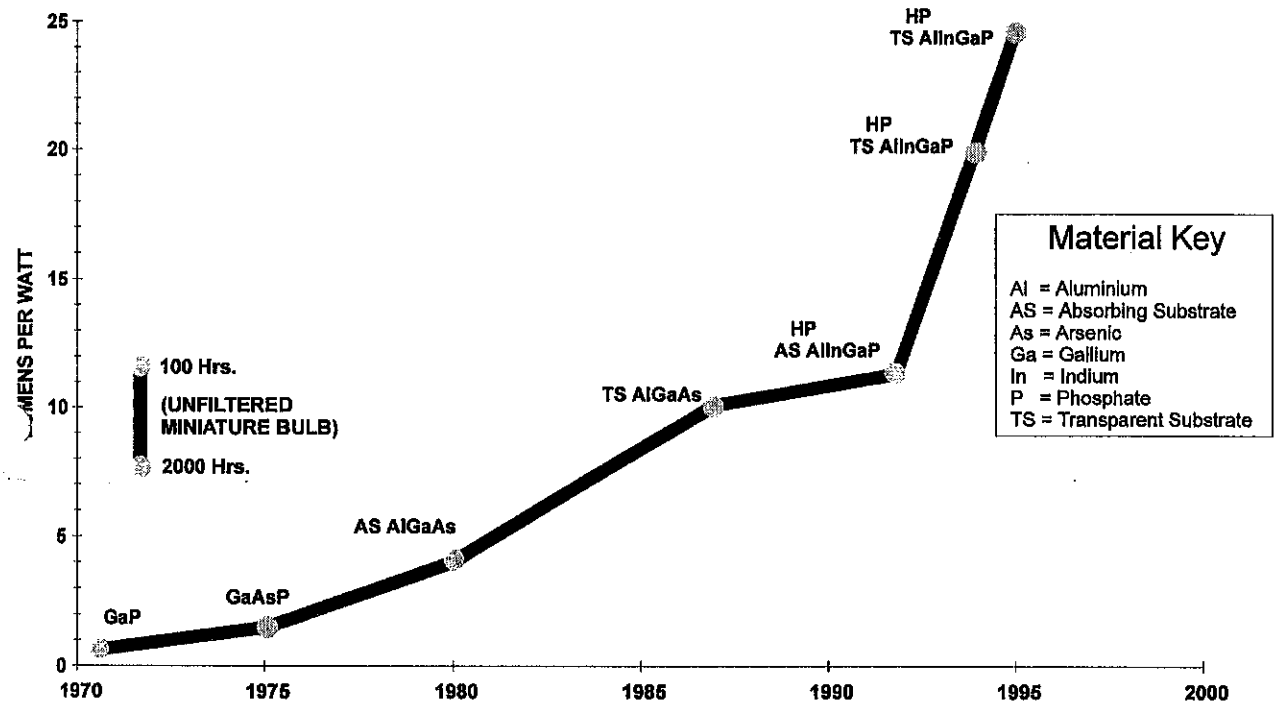
Technology advances of the photometric efficiency of Light Emitting Diodes (LEDs) are now making this technology suitable to for rear signal lighting.

Hella New Zealand designed the first signal lamp utilizing LED technology in early 1990, since that time this technology has come a long way.

The first illustration shows the rapid efficiency gains of LEDs over the last few years. LEDs have surpassed incandescent lighting in 1992 and now boast up to 24 lumen per watt. The performance improvement has been rapid and it is predicted that there will now be a period of modest improvement with manufacturing technology being improved.

The next quantum leap in performance beyond the TS AlInGaP material, shown on the chart, is up to 5 years away.

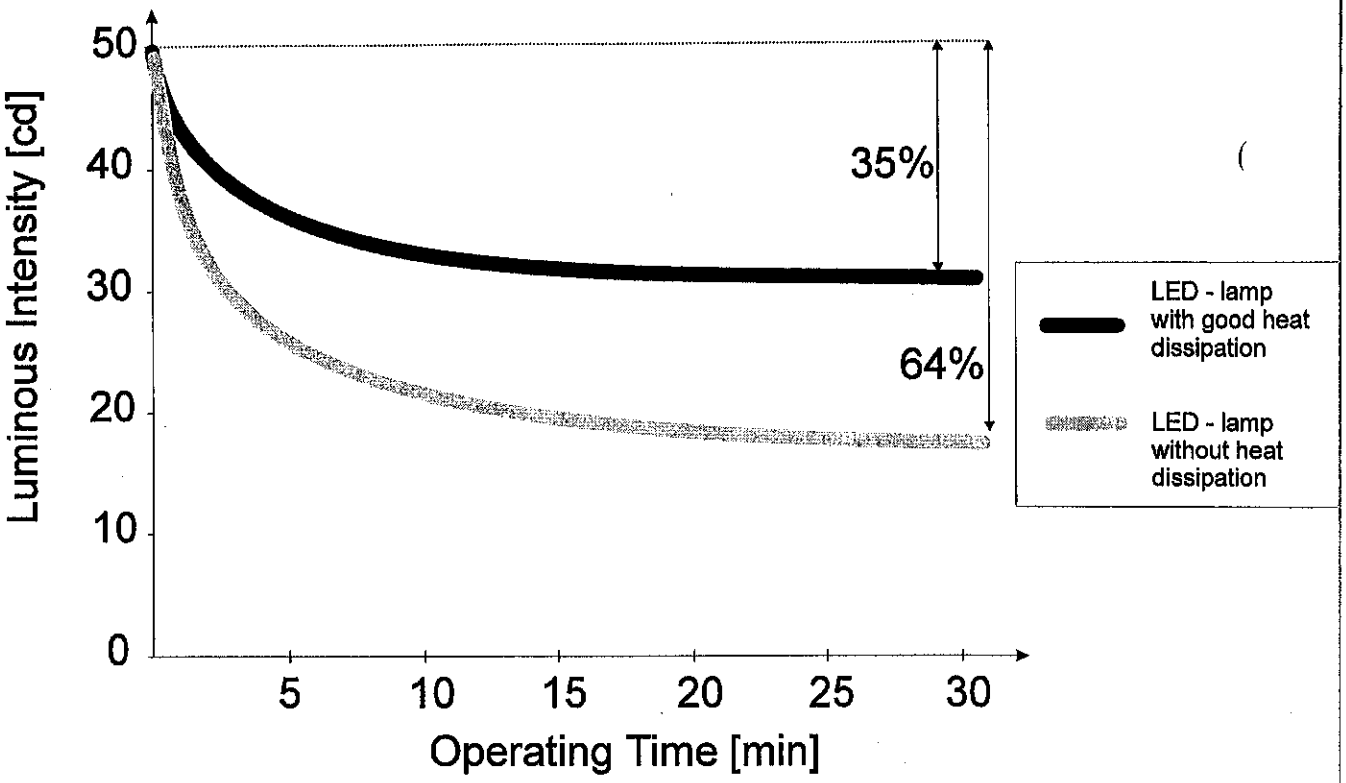
HISTORY OF L.E.D. PERFORMANCE



LEDs have a number of advantages over conventional bulb designs however LED lamp designs also have to take a number of peculiarities of this light source into consideration.

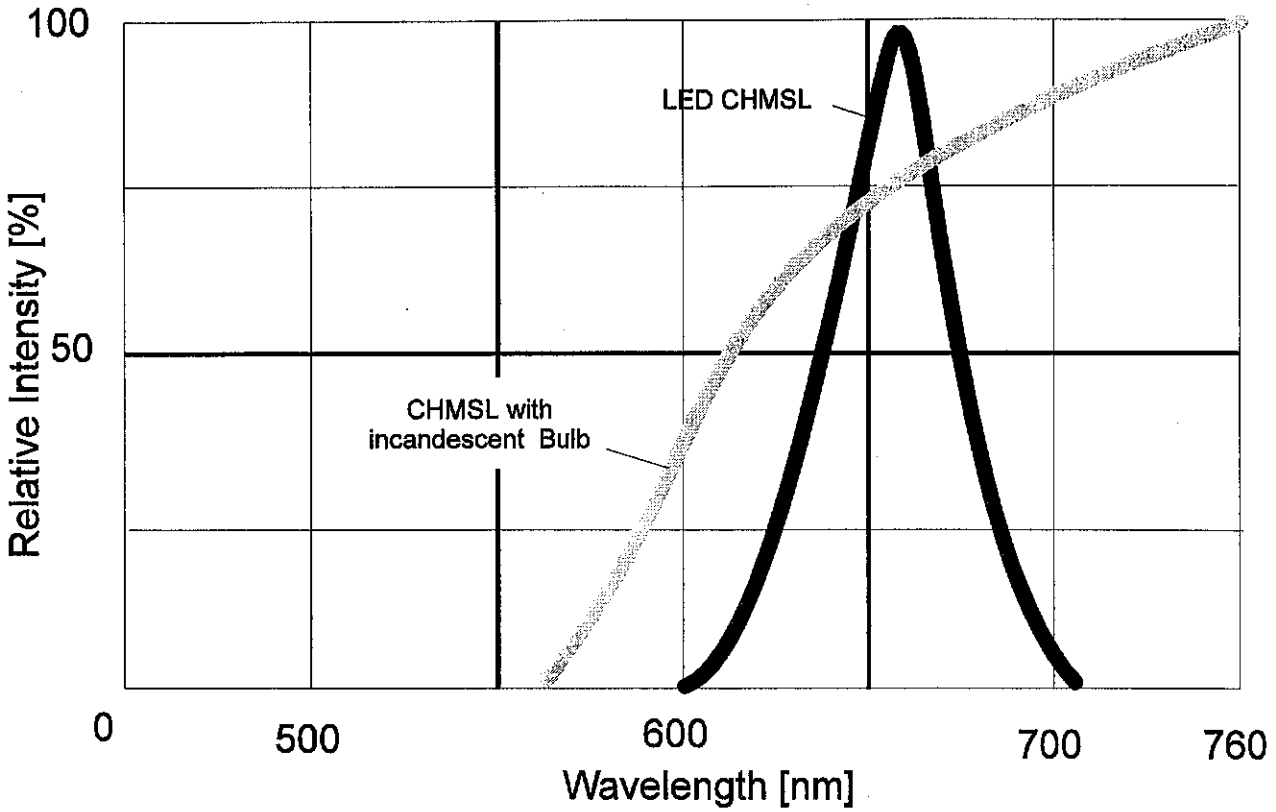
The chart below shows a correlation which is peculiar to LEDs, they reduce light intensity when they heat up. A good heat sink is an important design feature.

REDUCTION OF LUMINOUS INTENSITY OF LED LAMPS



LEDs operate in a very narrow colour spectrum.

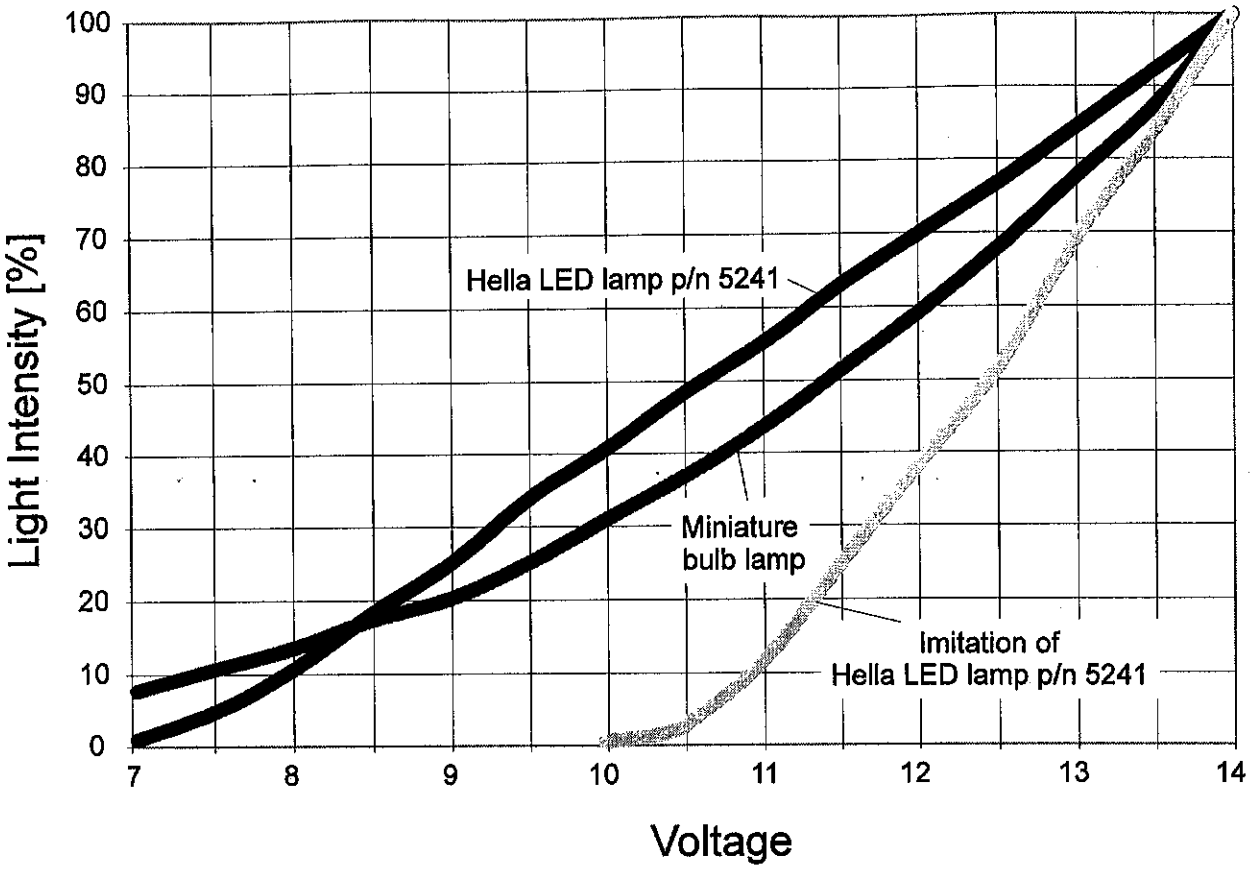
The chart below shows the colour spectrum comparison of LEDs versus incandescent bulbs.



LED lamps contain electronic circuitry. This circuitry provides protection for the LED components but also gives the lamp certain characteristics such as the correlation between input voltage and photometric performance.

The chart below shows that there can be marked differences between lamps with respect to this correlation.

It is obviously a safety advantage and desirable to have the lamp working over a larger voltage range.



Main technical considerations LED rear lighting for the transport industry

- LED lamps offer maintenance free service life for > 10.000 hrs., if the electronic circuitry is designed to protect the LEDs from overheating.
- LED lamps can be designed fully sealed.
- LED lamps, if properly designed will withstand the most severe vibration and shock conditions.
- LED lamps are polarity conscious.
- LED lamps consume only 10% -15 % of the wattage of an equivalent incandescent lamp.
- The low power consumption does produce a lower voltage drop. Important for long trailer units.
- It is a mandatory requirement to monitor the indicator function on trucks. A low power consumption LED lamp would require a modified monitor. The infinite life of the LED lamp might be deemed to make the monitoring function superfluous. (Requires regulation change)
- Damaging to LEDs lamps are over-voltages and voltage spikes due to load dump conditions.