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Optical Developments in Railway Signalling

In the last five years, over 14,000 new signals have been introduced on the UK rail network[1]. The common feature of these signals is the use of light emitting diode (LED) technology for the production of light. Such is the rate of technical development of LEDs that we now see a variety of technical solutions from signal manufacturers, and the dependency on standardisation and assessment has never been higher. The potential benefits of LEDs in railway signalling applications include:

- Potential for improved service life and reliability of signal,
- Reduced maintenance costs,
- Mechanically robust
- Possible to design without coloured filters, thereby reducing or avoiding 'phantom' aspects
- Scope to increase optical performance
- Scope to increase signal sighting and reduce the size and cost of support structures.

Figure 1 *LED Signals at Ebbw Junction, Newport area, 2007 (photo courtesy Andrew Denholm, Network Rail).*

These benefits are currently being realised by Network Rail with approved LED Colour Light Signals and LED Position Light Junction Indicators (See Figure 1), and further products on trial, including LED colour light signals from alternative suppliers, LED Banner Repeating Signals (including the new 'Repeating Green Aspect'), and LED Position Light Junction Indicators.

The reliability benefits of the LED Position Light Signal (Dorman 'GPL') is illustrated in Figure 2, which shown an abrupt reduction in the failure rate upon installation of the GPLs in the Cardiff PSB area. The single failure occurrence after the GPL occurrence was attributable to the only remaining conventional signal[2].

However, LED signals require higher levels of design and engineering than many would realise. Earlier LED products did not exactly fit the railway signalling colour specifications, and the semiconductor ingredients of yellow LEDs suffered from thermal stability problems (see Figure 3). LEDs are also highly reflective, which can give rise to sunlight reflection problems unless this has been taken into account with the design.

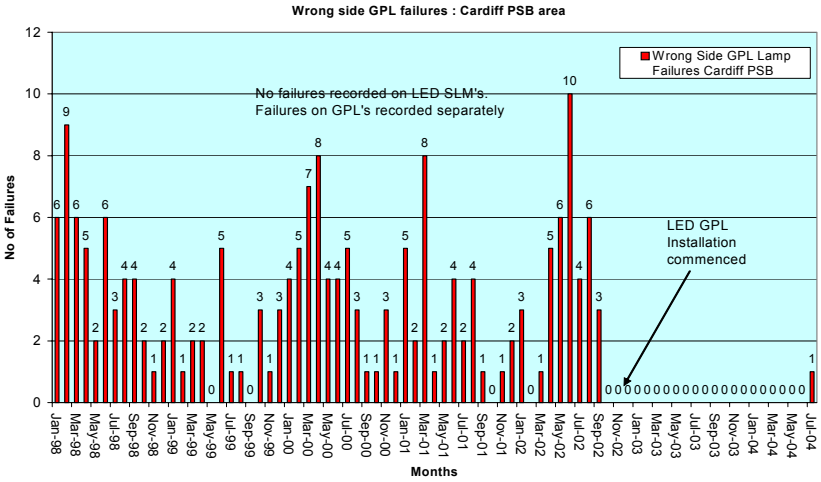
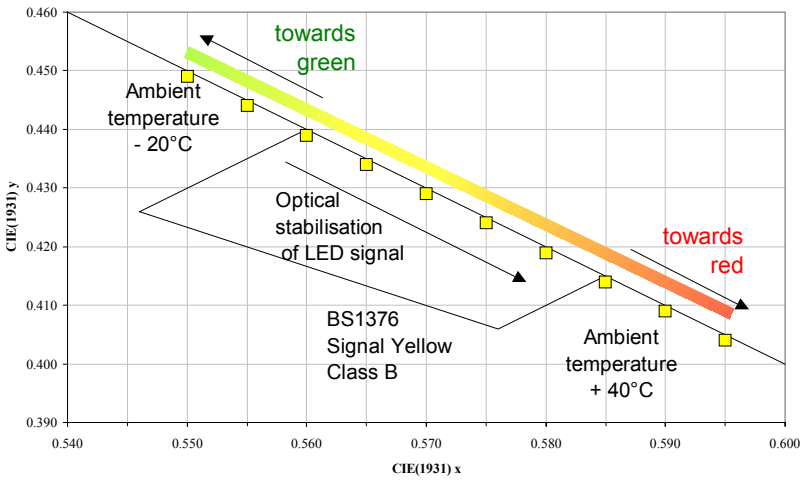


Figure 2 *Wrong-Side GPL Failures in the Cardiff PSB area (courtesy Network Rail).*

[1] Dorman
[2] Network Rail



A number of sophisticated LED signal designs are emerging from UK manufacturers and these are addressing the end-users' needs, in terms of confidence in the product with increasing service track record, and improved thermal stability of the design. One of the most difficult design criteria can be the setting of brightness levels such that the signal is sufficiently bright to be readable in direct sunlight, and not so bright that it causes excessive glare during the hours of darkness.

Figure 3 *Diagram to illustrate colour stability problems associated with yellow AlInGaP LEDs.*

To this end, controlled readability tests form a valuable element of the optical assessment process. The benefits of such work include bringing optically compatible signals to the market place and involving key stakeholders in the product development process, enabling them to become familiar with the design before it enters service. The benefits of LEDs in railway signalling applications are opening up further possibilities. However, technical challenges remain, and these should not be under-estimated.

We predict that lineside signals are likely to prevail for a considerable time, during which LEDs will continue to develop. LEDs will remain the first choice of light source for railway signals for some time ahead. Accordingly, the development of such signals should match the requirements of train drivers, not the other way round. Some development of the applicable standards and specifications may be required, in order to fully describe the performance requirements for such signals in a way that continues to encourage manufacturers' innovation. In order to bring best practice to optical measurement techniques, a '***Best Practice guide for the Optical Measurement of LED Clusters'*** is in the process of being published, and will shortly be available at www.npl.co.uk and www.opticonsultinguk.com

This article is based on a presentation given by Hugh Barton to InfraRail 2008.

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