By Daniel Stern, Driving Vision News

Everyone knows the benefits of LEDs for brake and signal lighting: they last forever, they light up quickly, they take much less power than a filament bulb to produce equivalent light, they offer new packaging and styling possibilities, and so on. But there are pesky new difficulties arising, as often happens when new technologies collide with older testing and regulatory practices.

LED brake and tail lamps have quickly and almost completely come to predominance on trucks and buses in North America. In that market, almost all large commercial vehicles use one of just a few standard rear lamp formats, by far the most popular of which is the 100mm (4-inch) diameter round. Lamps of this format are the smallest circular lamps that meet the U.S. Effective Projected Luminous Lamp Area (EPLLA) requirement. On vehicles wider than 203 cm, brake and tail lamps must have an EPLLA of 75cm^2 . It is not permitted to accumulate the required EPLLA with multiple lamps; no matter how many brake and tail lamps are fitted, each and every individual lamp must meet the EPLLA requirement by itself. An ordinary bulb-type 100mm lamp (accounting for occlusion by the mounting bezel) is just barely above 75cm ^{2} ; its whole lens area is lit. But most LED 100mm round lamps use multiple emitters. When powered, these lamps produce a visual signal of between 5 and 40 dots with dark space amongst the emitters.

The dark space isn't lit and so can't be counted when calculating the lamp's EPLLA. But the regulation does not provide a definitive method for measuring a lamp's EPLLA. The assumption, based on lamps equipped with conventional filament bulbs, is that the only unlit areas might be round the edges of the lamp. Compliance testing labs and industry working groups have devised and proposed various methods of measuring EPLLA, and some of these appear to give consistent, realistic, repeatable results—but none of them is an official method. Meanwhile, American regulators have raised concerns about lamps on the road that don't meet EPLLA requirements, but there's been little enforcement action, probably due in part to the lack of an official test protocol. For now, there are noncompliant lamps on the road and nobody's quite sure what to do about it.

Nor is it entirely clear what the relative safety effect is of this particular kind of noncompliance.

US regulations are very particular about large vehicles requiring larger brake lamps than smaller vehicles; other regulatory systems make no such distinction, and it's difficult to point to a discernible safety gap between countries that do and countries that don't require large brake lamps on large vehicles. Moreover, one of the big advantages of LEDs—their low power consumption—is typically lauded for its reduction in CO_2 emissions, but it has another very good effect: it reduces or eliminates the safety performance effect of voltage drop upon the lamp. Surveys done in the 1990s showed severe voltage drop at the rear of large truck trailers, with many providing only barely 9.5 volts due to the long length of the wiring. A filament bulb rated for 12.8 volts and operated at 9.5 volts produces only 36 percent of its rated output; a bulb-type brake lamp would have to produce 222 candela at 12.8v—near the 300cd maximum allowable intensity—to produce the bare-minimum 80cd allowed for the brake lamp function when operated at 9.5v. LEDs neatly do away with the problem; not only is their power consumption so low as to markedly reduce voltage drop on any circuit, but most LED lamps have control circuitry designed to keep the output constant despite wide variance in supply voltage, from 9 to 16 volts for a nominal 12-volt lamp.

So, yes, we now have lamps that are effectively too small to comply with the regulation…but they have replaced lamps that were practically too dim to comply with the regulation. It is tempting to believe the present situation is better than the previous: insufficient lit area due to lower-than-specified EPLLA can easily be effectively (if not legally) remedied by using multiple lamps, while insufficient intensity due to voltage drop cannot, and is in fact greatly aggravated with each additional power-sucking lamp added to the circuit. Of course it is best to have lamps that are both bright enough and large enough, as installed and operated, to comply with the regulation. But until an EPLLA measurement and certification method can be agreed, that will largely remain an unachieved ideal. This kind of conundrum is definitely not limited to the relatively mundane domain of goods trucks and transit coaches, and it illustrates the difficulties created as technology evolves at a quicker pace than that of regulations. This is particularly problematic under a reactive regulatory regime such as that in the United States: anything not specifically prohibited is permitted, so regulations are in effect perpetually obsolete, and practitioners are thus often forced to creatively apply old regulations to new technology. The opposite is true under the ECE system; anything not specifically permitted is prohibited. That approach brings its own problems, of course, which are the subject for another column.