



U.S. Department
of Transportation

**National Highway
Traffic Safety
Administration**

Office of the Chief Counsel

1200 New Jersey Avenue SE.
Washington, DC 20590

February 13, 2024

Mr. Mark Baker, B.S.E.E.
Soft Lights
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Beaverton, OR 97008
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Dear Mr. Baker:

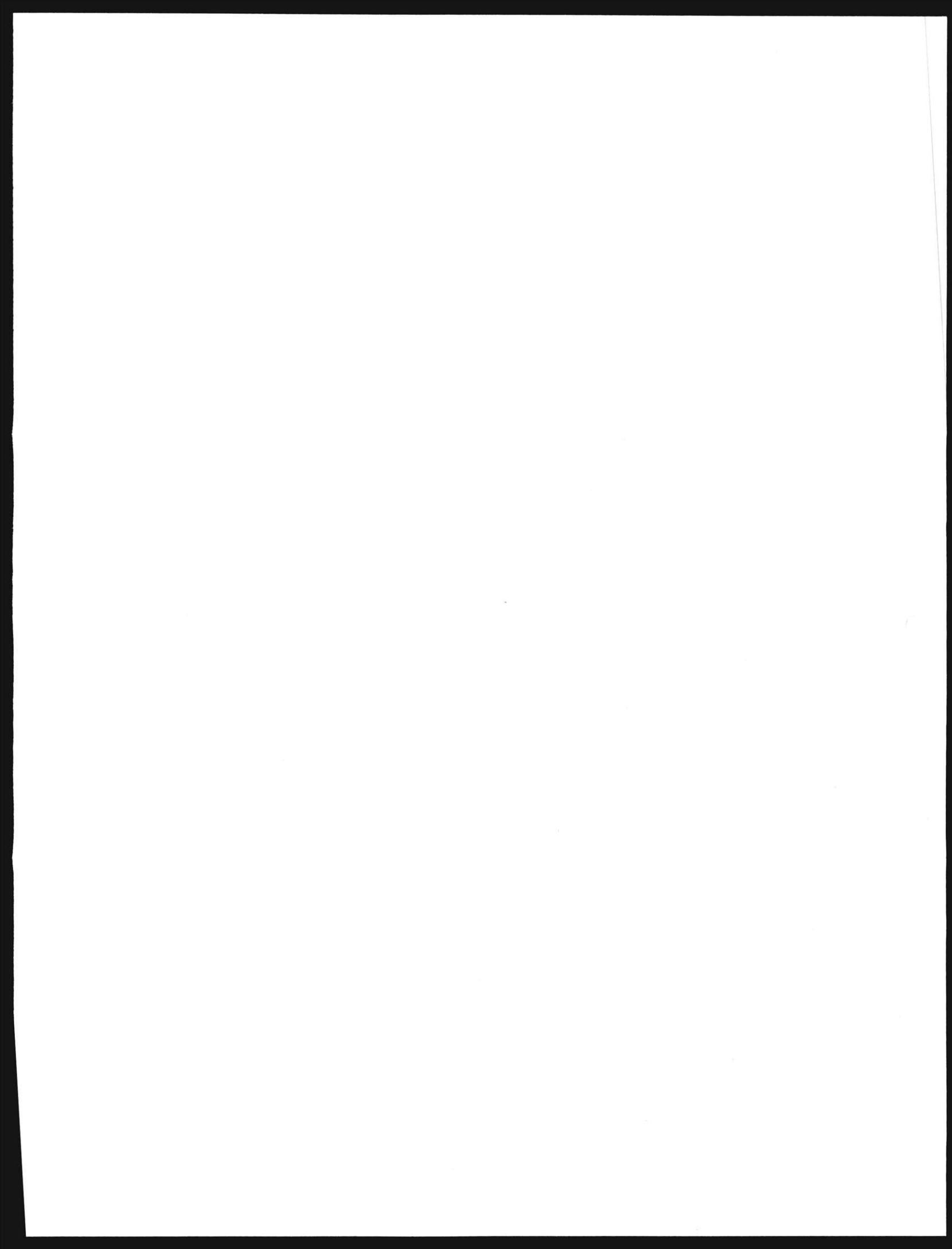
This responds to your letter and email dated June 27, 2021 and October 31, 2021, respectively, regarding the legal status and safety of motor vehicle headlamps that use light-emitting diode (LED) technology as the light source. Please note that our answer below is based on our understanding of the specific information provided in your letter and email.

You ask about the “legality of LED headlights.” You state your belief that Federal Motor Vehicle Safety Standard (FMVSS) No. 108 does not regulate “peak luminance, absolute spectral power distribution or flicker” and that the standard “only applies to spherical emitters such as tungsten-filament and gas-discharge and is not applicable to non-uniform luminance flat-source emitters such as LED chips.” You ask whether it is “NHTSA’s position that FMVSS No. 108 is only applicable to uniform luminance emitters which can be regulated by setting maximums for luminous intensity without the need of setting peak luminance maximums” and whether “NHTSA [has] approved the use of spatially heterogeneous visible radiation for use as the light source used in vehicle headlights.” You state your concerns about adverse health impacts due to the performance characteristics of LEDs, such as high peak luminance, high-color temperature, high-energy blue wavelength light, and flicker. You request NHTSA’s opinion about the “sufficiency” of FMVSS No. 108 regarding these health concerns.

We understand you to use “uniform luminance emitters” to refer to filament (halogen/tungsten) and high-intensity discharge (HID) light sources, and “non-uniform” or “heterogenous emitter” to refer to LED light sources. We therefore understand you to be asking whether LEDs are legal as a light source in motor vehicle headlamps under FMVSS No. 108, and, if they are legal, what is NHTSA’s position on the safety of LED light sources in headlamps with respect to “eye safety, mental safety, and visual performance.”

Background

NHTSA is authorized by the National Traffic and Motor Vehicle Safety Act (Safety Act, 49 U.S.C. Chapter 301) to issue FMVSS that set performance requirements for new motor vehicles and new items of motor vehicle equipment. The Safety Act requires manufacturers to self-certify that their



vehicles and equipment conform to all applicable FMVSS in effect on the date of manufacture. NHTSA also investigates safety-related defects.

FMVSS No. 108, "Lamps, reflective devices, and associated equipment," applies to "[p]assenger cars, multipurpose passenger vehicles, trucks, buses, trailers (except pole trailers and trailer converter dollies), and motorcycles" and covers, among other things, "original and replacement lamps, reflective devices, and associated equipment" for motor vehicles. The standard specifies performance requirements for headlamps. The most common types of headlamps are integral beam (S10.14) and replaceable bulb (S10.15, S11) headlamps.

NHTSA has stated that LED light sources are permitted as part of an integral beam headlamp if they are wired in series such that a failure of one LED would cause all the LEDs to cease functioning, and they otherwise comply with all relevant FMVSS.¹ Paragraph S4 of FMVSS No. 108 defines an integral beam headlamp as "a headlamp ... comprising an integral and indivisible optical assembly including lens, reflector, and light source, except that a headlamp conforming to paragraph S10.18.8 or paragraph S10.18.9 may have a lens designed to be replaceable." The standard does not contain performance requirements for a light source that is part of an integral beam headlamp, but instead specifies performance requirements for the complete headlamp. These include (among other things) photometry, through minimum and maximum candela at specified test points,² color, which must remain within specified boundaries,³ and that the headlamp be steady burning.⁴

While LED light sources that are part of an integral beam headlamp are permitted as noted above, no LED light source is currently permitted to be used in a replaceable bulb headlamp. FMVSS No. 108 contains specific requirements for the replaceable light sources (i.e., bulbs) used in replaceable bulb headlamps. These requirements are intended to support light source interchangeability. Paragraph S11 of the standard requires that "[e]ach replaceable light source must be designed to conform to the dimensions and electrical specifications furnished with respect to it pursuant to part 564 of this chapter[.]"⁵ Part 564 requires that replaceable bulb manufacturers submit to NHTSA for review and acceptance various design specifications for the bulb. If accepted, this design information is then placed in a publicly available docket to facilitate the manufacture and use of those light sources. As of the date of this letter, no submission that includes LEDs as the light source for a replaceable bulb headlamp has been listed in the docket. Therefore, no LED replaceable light source may be used in a replaceable bulb headlamp.

¹ Letter from Stephen Wood, Acting Chief Counsel, NHTSA, to Takayuki Amma, Manager, Koito Manufacturing Co. (Dec. 21, 2005). Letter from O. Kevin Vincent, Chief Counsel, NHTSA, to Junichi Hasegawa, Stanley Electric Co. (Apr. 8, 2013). Interpretation letters are available on NHTSA's online interpretations database at <https://www.nhtsa.gov/nhtsa-interpretation-file-search>.

² Photometry requirements for headlamp systems can be found in FMVSS No. 108, Tables XVIII and XIX.

³ See FMVSS No. 108, Table I-a (headlamp color). Chromaticity requirements are pursuant to FMVSS No. 108 S14.4.

⁴ See FMVSS No. 108 Tables I-(a and c). NHTSA has stated that "steady burning" means "light that is essentially unvarying in intensity." See Letter from Frank Berndt, Chief Counsel, NHTSA, to United Sidecar Association, Inc. (Feb. 9, 1982). A device may fail to meet this requirement where the driver "would not see a signal that was consistent or reliable in its meaning." See Letter from Paul Jackson Rice, Chief Counsel, NHTSA, to Bob Abernathy, Idea's Inc. (Sept. 7, 1990) (applying steady burning in a taillamps context). In the context of a modulating motorcycle headlamp, we have stated that "there is no failure to conform if the modulating light from the lamp is perceived to be a steady beam." Letter from John Womack, Acting Chief Counsel, NHTSA, to Joe De Sousa (March 10, 1994).

⁵ See Letter from John Womack, Acting Chief Counsel, NHTSA, to Nancy Tavarez, Beatrix Industries (Aug. 30, 1995) (clarifying application of Part 564 to replaceable headlamp bulbs).

Discussion

Pursuant to FMVSS No. 108, paragraphs S4 and S10.14, LEDs are allowed to be used as a light source in integral beam headlamps as long as the headlamp conforms to all applicable headlamp requirements in FMVSS No. 108. However, LEDs are not currently permitted in a replaceable bulb headlamp. Nevertheless, illegal LED headlamp replaceable light sources may be available for purchase on the internet, and although these lights do not conform to the requirements of FMVSS No. 108, some consumers purchase and install these LED light sources in their replaceable bulb headlamps. While NHTSA regulates the manufacture and sale of light sources, it generally does not regulate the modifications individuals make to their own vehicles. It is therefore left to State law to address installation of an LED replaceable light source in a headlamp.

FMVSS No. 108 does not directly regulate what you describe as peak luminance as measured in nits or the spectral power distribution of the headlamp light source. However, this is indirectly regulated through the headlamp performance requirements, such as the photometry and chromaticity requirements. Additionally, flicker is regulated through the requirement that lower beam headlamps be steady burning. We also note that, although FMVSS No. 108 requires that the light emitted by headlamps be white, the permissible boundary of white includes colors that may be perceived by the human eye as white with a yellow tint and white with a blue tint.⁶

In your communications, you raise concerns about the health impacts of LED headlamps. We are aware of concerns raised about possible adverse effects of certain LED devices, particularly as used in street lighting that emits excess blue light.⁷ NHTSA's focus is on automotive safety, but the agency recognizes that separate expertise resides in sister agencies that are health-focused, such as the Food and Drug Administration.

I hope this information is helpful. If you have any further questions, please feel free to contact Eli Wachtel of my staff at this address or at (202) 366-2992.

Sincerely,



John Donaldson
Acting Chief Counsel

⁶ Letter from Frank Seales, Jr., Chief Counsel, NHTSA, to Richard Hodson, (July 4, 2000) (stating that "SAE J578c defines white by blue, yellow, green, red, and purple boundaries within a chromaticity diagram. Thus, it is possible to design a headlamp that emits a light that approaches the blue boundary and is perceived as having a blue tint but which nevertheless remains within the boundaries that define "white." These headlamps would comply with the color requirements of Standard No. 108.").

⁷ See "AMA adopts guidance to reduce harm from high intensity street lights," American Medical Association, June 14, 2016, available at <https://www.ama-assn.org/press-center/press-releases/ama-adopts-guidance-reduce-harm-high-intensity-street-lights>.