



Transportation Safety Equipment Institute

Brake/Stop Lamp Operation Regulations Need Updating

Background

The growth of light-duty, medium-duty, and heavy-duty vehicles powered by electric motors demands a reexamination of the regulatory requirements that specify when stop lamps must activate. Recent Federal Motor Carrier Safety Administration (FMCSA) exemption approvals for auxiliary brake lamps that flash or pulsate when the brake pedal is depressed have not been addressed by the National Highway Traffic Safety Administration (NHTSA). With the advent of LED lamps that are controlled by sophisticated electronics, NHTSA regulations put into place decades ago (thus predating the LED era) need to be modernized, considering new information derived from neuroscience and human factors research. Safety statistics based on distracted driving must also be addressed. Autonomous vehicles are in their infancy, and now is the right time to establish how they will perceive the environment, detect vulnerable road users, and respond to stimuli registered by their sensors and cameras.

Federal Motor Vehicle Safety Standard (FMVSS) No. 108 refers to these devices as “stop lamps.” This terminology finds its origin in two SAE standards, which were incorporated by reference into versions of FMVSS 108 prior to NHTSA’s 2007 administrative rewrite of the standard. SAE J586 (1984) (1) and SAE J1398 (1985) (2) define “stop lamps” as “lamps which indicate the intention of the operator of a vehicle to stop or diminish speed by braking.” However, stop lamps are essentially braking lamps, which indicate an intention of the driver, regardless of what the vehicle is doing. For instance, if a driver releases his or her foot from the accelerator pedal, the vehicle will slow. This could be defined as a driver intent to slow the vehicle, but this simple action does not command illumination of the lamps.

Consider the following design intents and situations.

- A vehicle with an automatic transmission has an “urge to move” based on the hydraulic torque converter having torque from the movement of the mechanism and the hydraulic fluid. This requires the driver to keep a foot on the brake pedal to avoid the vehicle moving, except on an incline of “just the right” angle where the forward torque overcomes the gravity of the vehicle.
- When automated mechanical transmissions were introduced, they were initially designed to replicate this urge to move to enhance driver acceptance. This was done by “slipping the clutch.” The clutch would slightly engage to provide a similar feel, but would have to be released if the temperature rose too high. Thus, the vehicle would sometimes rock back and forth slightly.
- In a mechanically clutched transmission, if the vehicle is on a flat section of road, there is no need to press the brake pedal to avoid the vehicle moving. On an incline, it may be necessary to press the brake pedal to avoid the vehicle moving forward or rolling back.
- With the push for reduction in emissions in transportation, several manufacturers have introduced a feature to stop the engine from running when the vehicle is stationary for some period of time. The engine may restart on its own to maintain electrical energy for accessories (such as air conditioning, heat, and

entertainment) powered by the alternator and battery. The engine may be programmed to restart when the driver removes the foot from the brake pedal or when the accelerator pedal is depressed. It may not be necessary to depress the brake pedal when stopped.

- Diesel-powered vehicles may have a motion retarder, such as an exhaust or hydraulic retarder. For heavy-duty vehicles operating in mountainous terrain, installation of a retarder can be exceptionally important. Since these devices do not require the brake pedal to be depressed in all implementations, when activated, the stop lamps may or may not illuminate.
- New electrically powered vehicles often have a feature to use the regenerative forces of the motor to slow the vehicle. Many such vehicles allow for “one pedal” operation, making it possible to bring the vehicle to a completely stationary state without depressing the brake pedal. It does not appear to be standardized as to when or if the stop lamps should be illuminated under such conditions. Some vehicles sense that the vehicle is stationary and will illuminate the stop lamps even if the brake pedal is not depressed. Others will illuminate the lamps if the vehicle is decelerating at some arbitrary speed that may not be related to the weight and speed of the vehicle (which are important to determine the time and distance to stop).
- Electric vehicles often have a hold mode to prevent the vehicle from rolling back when on an incline. In the hold mode, no brake pedal is depressed.
- FMCSA has approved several five-year exemptions to allow the use of flashing/pulsating auxiliary lamps on vehicles when the brake pedal is depressed. Those exemptions do not address the situations illustrated above.
- The use of electronically controlled LEDs significantly changes what is possible to control the timing and intensity changes of a lamp.

In 2009, NHTSA provided an interpretation to Eaton on its Hydraulic Launch Assist (HLA). That product provided some retardation, and Eaton was uncertain what telltales per FMVSS 101 needed to be included and whether the stop lamps needed to be illuminated. NHTSA’s response can be found at <https://www.nhtsa.gov/interpretations/07-003933as>(3). The Agency’s response indicated overlap among FMVSSs 101, 105, 108, 121, and 135. A key point was that the HLA is not “service brakes”. Another was that FMVSS 105 defines a Regenerative Braking System (RBS) for electric and hydraulic braking. The RBS may or may not be part of the defined “service brake”.

Although potential updates to FMVSS 108 are on NHTSA’s radar (6), the current (Spring 2024) Unified Agenda (4) does not indicate any impending action in this regard. NHTSA-2020-109 (7) did request comments on several FMVSS test procedures related to air brakes but did not include FMVSS 108. Bosch did submit a response to the request that primarily related to test procedures in FMVSS 108, especially for adaptive driving beam (ADB).

There are potentially other occasions when the stop lamps can, may, or should be illuminated, flashed, or pulsated.

Conclusions and Recommendations

- Technology and our understanding regarding how the brain and eye function have advanced significantly over the last two decades.
- There is overlap among FMVSS 101, 105, 108, 121, and 135. NHTSA is adapting non-lighting regulations to address Automated Driving Systems.

- The Transportation Safety Equipment Institute recommends that NHTSA closely study current lighting and conspicuity technologies and behavioral and neuroscientific research, as well as exemptions, implementations, trends, state regulations, and other federal agency regulations (FHWA, FMCSA, etc.) to inform a rewrite of FMVSS 108 before 2027 with a compliance target of September 2029 (MY 2030).

References:

- (1) SAE J586 (Feb 1984) STOP LAMPS FOR USE ON MOTOR VEHICLES LESS THAN 2032 MM IN OVERALL WIDTH
- (2) SAE J1398 (May 1985) STOP LAMPS FOR USE ON MOTOR VEHICLES 2032 mm OR MORE IN OVERALL WIDTH
- (3) <https://www.nhtsa.gov/interpretations/07-003933as>
- (4) https://www.reginfo.gov/public/do/eAgendaMain?operation=OPERATION_GET_AGENCY_RULE_LIST¤tPub=true&agencyCode=&showStage=active&agencyCd=2100&csrf_token=614B67E4F64BCB56A550EDF77DD7BB2E0AFE7F8ACC20815E2F7B22A91A0816A9622BA036E1ECDBC773D1891B59B25B91F1CE
- (5) https://www.reginfo.gov/public/do/eAgendaMain?operation=OPERATION_GET_AGENCY_RULE_LIST¤tPubId=202304&showStage=longterm&agencyCd=2100&csrf_token=614B67E4F64BCB56A550EDF77DD7BB2E0AFE7F8ACC20815E2F7B22A91A0816A9622BA036E1ECDBC773D1891B59B25B91F1CE
- (6) <https://www.reginfo.gov/public/do/eAgendaViewRule?pubId=202304&RIN=2127-AL95>
- (7) https://lindseyresearch.com/wp-content/uploads/2021/02/NHTSA-2020-0109-0012-20210208_Bosch_response_ANPRM_FMVSS_Final_Version.pdf

This Policy/Position Paper was adopted per Section 4, paragraph “i” of the TSEI ByLaws dated 20 July 2022