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March 28, 2014

The Honorable David Friedman
Acting Administrator
National Highway Traffic Safety Administration
1200 New Jersey Avenue S.E., West Building
Washington D.C. 20590-0001

Dear Acting Administrator Friedman:

Petition for Rulemaking to Update and Upgrade
Federal Motor Vehicle Safety Standard No. 111, "Rearview mirrors"
to allow
Camera–based Systems as a Compliance Option

On behalf of the members of the Alliance of Automobile Manufacturers[1] and Tesla Motors, Inc. (collectively the "Petitioners"), pursuant to Part 552 of Title 49 of the Code of Federal Regulations (CFR), this submission petitions the National Highway Traffic Safety Administration (NHTSA) to update Federal Motor Vehicle Safety Standard (FMVSS) No. 111, "Rearview mirrors" with a compliance option that reflects new and emerging technology. Petitioners ask NHTSA to allow the use of camera-based rear and/or side vision systems as a compliance option for meeting the performance requirements specified for rear and/or side view mirrors for each location where conventional mirrors are currently required or permitted (i.e., applicable portions of 49 CFR 571.111 S.5, S.6).

Camera-based supplemental vision systems are currently available on several production vehicles in the United States. Examples of these systems include: the Nissan Around View Monitor and the Mercedes-Benz Surround View System, which aid drivers in parking and other low speed maneuvers; the Honda LaneWatch™ system that provides the driver with an up-close view of any right lane traffic in their blind spot via a display on the navigation screen, to assist when preparing to change lanes; and the Mercedes-Benz Night View Assist Plus that supplements the real-time view of the road with enhancements for low light conditions. In addition, a test fleet comprised of Volkswagen XL1 models fitted with rear and side view camera systems operating in Europe today.

[1] The Alliance is a trade association with the following members: BMW Group, Chrysler Group LLC, Ford Motor Company, General Motors Company, Jaguar Land Rover, Mazda, Mercedes-Benz USA, Mitsubishi Motors, Porsche, Toyota, Volkswagen Group of America and Volvo Cars. Nine out of the 20 *"Most Innovative Companies"* worldwide are automakers according to The Boston Consulting Group, a global management firm. More automakers appear on this list than technology or telecom companies.

In light of future greenhouse gas and corporate average fuel economy requirements beginning in 2017, camera-based systems represent an opportunity to increase vehicle fuel efficiency through improved aerodynamics by eliminating externally mounted mirrors. The Petitioners maintain that this fuel efficiency benefit is possible without compromising the performance requirements stated in FMVSS No. 111. Camera-based vision systems have matured to the point where these types of technologies have the potential to provide driver assistance consistent with the intent of the performance requirements of FMVSS No. 111.

In September 2013, NHTSA announced the addition of rearview video systems to its list of recommended features under its New Car Assessment Program (NCAP). This action demonstrates the agency's support for camera-based vision systems.

Given the foregoing, the Petitioners recommend that NHTSA amend FMVSS No. 111 as described in this petition.

Improvements to Fuel Economy

"Drag" is the force on an object that resists its motion through a fluid. When the fluid is air, it is called aerodynamic drag (or air resistance).[2] The equation that describes the aerodynamic drag for an object, like a car, moving through a fluid (air) is:

$$FD = \frac{1}{2}\rho v^2 CdA$$

In this equation, FD is the force of the drag, ρ is the density of the fluid, υ is the velocity, Cd is the drag coefficient and A is the reference area.

Aerodynamic drag increases with the frontal area of a vehicle. Drag also increases with vehicle speed. By reducing the frontal area of the vehicle, the aerodynamic drag will be reduced and fuel economy will increase.[3]

Replacing exterior side mirrors with camera-based side vision systems will reduce the aerodynamic drag of a vehicle. Hucho reports that exterior side view mirrors increase the total amount of a vehicle's aerodynamic drag by 2 – 7 percent.[4] Morel has estimated that a 10 percent reduction in aerodynamic drag would produce a 3.2 percent improvement in fuel economy.[5]

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[2] Imagine holding your hand out of an open window while riding in a moving car with the palm perpendicular to the ground.

[3] For example, a bicycle racer competing in the Tour de France can often be seen getting down low into a crouched position with elbows in, i.e., a more streamlined posture, to reduce their frontal area and thus, their aerodynamic drag.

[4] Hucho, H.W., Aerodynamik des Automobils, Wieweg+Tuebner, 5th ed., 2005.

[5] Hilliard, J.C and Springer, G.S., Eds., Fuel Economy in Road Vehicles Powered by Spark Ignition Engines, Plenum Press, New York, 1984.

The option to allow camera-based systems as a compliance option would provide additional flexibility for automotive manufacturers to innovate and address field of view, fuel economy, and aerodynamics challenges for specific segments of vehicles, while continuing to use conventional mirrors for other vehicles with equivalent safety levels.

Field of View Equivalence

Camera-Based System Meet Current FMVSS No. 111 Requirements

Mirrors provide a robust and simple means to view the surrounding areas of a vehicle and can also be adjusted to eliminate a blind spot.[6] While current field of view (FOV) requirements for mirrors provide a high level of safety, the capabilities of camera-based systems to further expand the driver's field of view can provide additional driver assistance. NHTSA's grant of this petition would be consistent with the agency's recently announced Strategic Plan to address the safety of the ever-growing population of older drivers. Camera-based systems have already been recognized as helpful to drivers who experience diminished upper body range of motion, enabling them to make full use of the available fields of view, including checking blind spots. For example, the website, "Smart Features for Older Drivers[7]," highlights rear cameras as "beneficial to older drivers with difficulty with mobility and neck movement."

Research in lane change crash scenarios have aided in developing vehicle-based crash avoidance systems. A 2011 NHTSA presentation noted that 9 percent of police-reported crashes in one year were characterized as "lane change crash" scenarios.[8] NHTSA also noted that those lane change crash scenarios may be addressed by vehicle-based crash avoidance systems including Blind Spot Detection Systems. Although these statistics do not differentiate between lane change crashes due to blind spot errors and lane change crashes due to look-but-don't-see errors, camera-based side vision systems may have a similar functionality as mirror-based Blind Spot Detection systems and therefore may help to reduce the chances of such incidents.

FMVSS No. 111 is intended to "provide a clear and reasonably unobstructed view to the rear." Camera-based systems have the ability to display a direct representation of the rearward FOV of the vehicle without the reflection angle considerations of traditional mirror systems, while also providing the same perspective, thereby displaying the whole FOV mandated by FMVSS No. 111.

By allowing a compliance option for FMVSS No. 111 to be met with camera-based systems, an expanded FOV is possible. Today, despite the standard, blind spots may still

[6] Platzer, G., "The Geometry of Automotive Rearview Mirrors - Why Blind Zones Exist and Strategies to Overcome Them," SAE Technical Paper 950601, 1995, doi:10.4271/950601.
[7] http://seniordriving.aaa.com/smartfeatures
[8] NHTSA Presentation, 2011 UMTRI Automotive Safety Conference (Feb. 16, 2011) *available at* http://www.umtri.umich.edu/content/John.Maddox.Safety.2011.pdf. This data uses 2007 NHTSA General Estimates System ("GES") data.

necessitate drivers to rotate their heads during lane changes and while merging with traffic. By adapting the optics and positioning, a camera-based system can potentially deliver an unobscured view to the horizon in all directions, encompassing all lanes. On-road testing performed by Tesla Motors indicates that a camera-based system has the potential to provide a FOV that eliminates blind spots[9]. Improving the FOV can enhance driver situational awareness, particularly in multilane freeway scenarios, and may decrease the likelihood of lane change errors.

With today's technology, cameras and monitors may, but need not, be located in the traditional space occupied by mirrors. Depending upon the placement of displays, the FOV achievable with a camera-based system is potentially greater than that of either an exterior mounted mirror or compensating behaviors such as head turns. With a camera-based system, the FOV can be displayed to the driver in a convenient location. This even may assist drivers with reduced mobility with maintaining peripheral vision of critical areas.

State of the Art Camera Development

As discussed in the preceding sections, a compliance option for the use of camera-based systems to meet FMVSS No. 111 would provide additional flexibility for automotive manufacturers to innovate in the areas of FOV and fuel economy. Compared to conventional mirror systems, the implementation of rear and side view cameras would be more complex, implicating magnification, resolution, time behavior, and image quality. Camera technology is evolving rapidly, and the Petitioners recognize that challenges associated with the more complex implementation of cameras can be addressed with state-of-the-art systems and even more so with software and hardware advances.

Performance Requirements

ISO 16505 – Road Vehicles – Ergonomic and Performance Aspects of Camera-Monitor Systems – Requirements and Test Procedures

ISO 16505, which is in the final stages of adoption, will provide minimum safety, ergonomic, and performance requirements as well as test methods for Camera-Monitor-Systems (CMS) as an acceptable optional replacement for currently mandated rear and side view mirrors for road vehicles. While final release is currently targeted for the November 2014 timeframe, the draft performance requirements contained in it appear to be sufficiently developed for the Petitioners to recommend it as the performance requirements appropriate for revisions to FMVSS No. 111 to incorporate such systems.

Recommended Performance / Test Requirements

While the Petitioners recommend that the agency consider adoption of performance specifications relevant for regulatory specification based on the latest draft of ISO 16505, the

[9] NHTSA Docket No. NHTSA-2013-0076, Entry No. 0016.

Petitioners are aware of an effort within the Working Party on General Safety Provisions (GRSG), which applicable regulations include UN ECE R46, Uniform provisions concerning the approval of devices for indirect vision and of motor vehicles with regard to the installation of these devices, to allow an optional replacement of rear and side view mirrors by camera-based systems. A kick-off for these activities began in October 2008. In 2010, GRSG Informal Working Group Camera Monitor Systems recommended a worldwide harmonized ISO standard, 16505, which could be used as a reference for the technical requirements. In early February 2014, the GRSG Working Group resumed its activities to incorporate ISO 16505 into UN ECE R46.

In the interest of harmonization, Petitioners recommend that ISO 16505 test procedures are suitable for United States' self-certification regulatory process.

Clarification of Preemption

Finally, the Petitioners note that the full benefits of the regulatory compliance option sought by this petition can be realized only if the manufacturers availing themselves of the option are also permitted to delete the driver's side mirror required by FMVSS No. 111 S.5.2 and, where applicable, the passenger's side mirror required by FMVSS No. 111 S5.3. The projected fuel economy savings are particularly dependent on the ability to delete these mirrors.

However, Petitioners also recognize that a number of state laws specify that motor vehicles registered in their states must be equipped with at least a driver's side mirror. For example, California Vehicle Code, Section 26709, provides in part that:

> "Every motor vehicle registered in a foreign jurisdiction and every motorcycle subject to registration in this state shall be equipped with a mirror so located as to reflect to the driver a view of the highway for a distance of at least 200 feet to the rear of such vehicle.
>
> Every motor vehicle subject to registration in this state, except a motorcycle, shall be equipped with not less than two such mirrors, **including one affixed to the left-hand side**. (Emphasis added)."

This is just one example of many state laws that require driver side mirrors (and in some cases, passenger side mirrors) to be mounted on motor vehicles registered in those states. Moreover, nearly all state laws require an inside rearview mirror.

As these state laws are largely harmonious with FMVSS No. 111 as currently written, before now there has been no need to evaluate whether these laws are preempted in whole or in part by the FMVSS. However, should NHTSA amend FMVSS No. 111 to permit optional compliance by means of camera-based systems in lieu of mirrors, NHTSA should simultaneously make clear that the availability of the compliance option would preempt any state laws

mandating mirrors. Under §30103(b) of the National Traffic and Motor Vehicle Safety Act, whenever an FMVSS is in effect, a state may "prescribe or continue in effect a standard applicable to the same aspect of performance of a motor vehicle or motor vehicle equipment only if the standard is identical to the standard prescribed under this Chapter." The aspect of performance at issue here is the rearward FOV for the driver. If NHTSA grants a compliance option that involves camera-based systems as an alternative to mirror-based systems, the compliance option would be applicable to "the same aspect of performance," and thus would preempt any inconsistent state laws.

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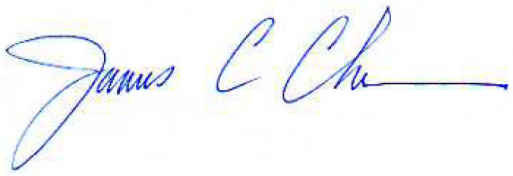
The Petitioners appreciate the agency's consideration of this petition and would be pleased to provide any additional information needed. Should you have any questions or require further information, please do not hesitate to contact Scott Schmidt at (202) 326-5545.

Respectfully submitted,

Alliance of Automobile Manufacturers, Inc.

Scott A. Schmidt
Senior Director, Safety & Regulatory Affairs

Tesla Motors, Inc.



James C. Chen
Vice President of Regulatory Affairs and
Associate General Counsel