

Performance Classification of Headlamp Outer Lenses

RATIONALE

The current standard metric for the durability of the headlamp lens is SAE J576. This practice requires 3 years of outdoor weathering of representative coated test plaques in place of the actual headlamp lenses. This practice is not conducive for optimizing the headlamp lens manufacturing processes to achieve longer service life than implied by the current 3-year weatherability requirement of SAE J576.

Additionally, 3-year outdoor weathering does not represent vehicle condition. Lenses on vehicles have curved surfaces, are impacted by small stones and sand at high velocities, and can experience thermal shock by car wash on a hot sunny day or when it rains during operation. Failure modes exhibited on vehicles are targeted in this test method and may not be correlated to 3-year weatherability.

The U.S. vehicle fleet is aging; the median age is greater than 12 years. At the time NHTSA implemented the 3-year outdoor weathering requirement, the median age of a vehicle was 5.7 years. Headlamp style progression has increasingly added content and features that greatly increase cost of replacement, resulting in headlamps which are considered a life-of-vehicle device, and yet the performance requirement for the outer lens has remained unchanged. Many headlamp lenses become hazed within the vehicle life cycle, resulting in reduced light output, increased glare, and poor appearance. This reduced performance affects the ability of the driver to see at night, and seeing distance is reduced which results in safety issues, especially for pedestrians. Since 2009, U.S. pedestrian fatalities at night have increased over 60%, with older vehicles predominately being involved in the fatal pedestrian crashes¹. One method to reduce pedestrian fatalities at night is to make headlamp coatings more durable in order to reduce haze and maintain functionality for the life of the vehicle. NHTSA demonstrated the marked reduction in naturally aged headlamps of the U.S. fleet in Docket No. NHTSA-2021-0061. In the NHTSA study it was shown that as much as a 65% reduction in the maximum light output value is common in a 10-year-old headlamp lens, and the 3 lx distance was reduced by 27%. This reduced lighting performance may have safety implications for pedestrians and drivers.

Without an approach to accelerate development of new coatings and a method to verify new coatings, the lighting industry had no way to quickly improve headlamp durability and to reduce nighttime pedestrian fatalities. There is strong interest for improving durability from the vehicle manufacturers, Tier 1, and Tier 2 suppliers, but a joint effort was needed to create a new performance classification method that represents actual vehicle failure modes and beyond the FMVSS regulatory requirement.

¹ <http://www-fars.nhtsa.dot.gov>

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Full document details: SAE J3086_202308

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https://www.sae.org/standards/content/J3086_202308/

This document lists a set of tests that are to be conducted on the actual headlamp lenses. The results generated by these tests quantify the performance of the headlamp lens. This information can be used by:

- a. The coating manufacturer to expedite development of new and better coatings by use of an accelerated test that represents vehicle conditions.
- b. The lamp manufacturer to improve their process, thereby, improving the performance of the headlamp lenses.
- c. The OEM to set a level of performance expected from the product and a validation method to verify performance.

This document provides a standardized, performance-based, classification protocol for the headlamp lens.

1. SCOPE

This SAE Recommended Practice is intended as a guide toward standard practice and is subject to change to keep pace with experience and technical advances. This document establishes performance requirements and guidelines for coating materials and plastic substrate testing.

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue of SAE publications shall apply.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

SAE J400	Test for Chip Resistance of Surface Coatings
SAE J576	Plastic Material or Materials for Use in Optical Parts Such as Lenses and Reflex Reflectors of Motor Vehicle Lighting Devices
SAE J2527	Performance Based Standard for Accelerated Exposure of Automotive Exterior Materials Using a Controlled Irradiance Xenon-Arc Appartus

2.1.2 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM D1003	Standard Test Method for Haze and Luminous Transmittance of Transparent Plastics
ASTM D3359	Standard Methods for Measuring Tape Adhesion by Tape Test
ASTM G155	Standard Practice for Operating Xenon Arc Light Appartus for Exposure of Non-Metallic Materials

2.1.3 Code of Federal Regulations (CFR) Publications

Available from the United States Government Printing Office, 732 North Capitol Street, NW, Washington, DC 20401, Tel: 202-512-1800, www.gpo.gov.

49 CFR Part 571.108	Lamps, Reflective Devices and Associated Equipment (FMVSS 108)
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