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# SURFACE VEHICLE RECOMMENDED PRACTICE

SAE J2009

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## (R) Discharge Forward Lighting System and Subsystems

***Foreword***

This document is being revised in order to encompass the technical advance and knowledge in discharge lighting technology for automotive use over the past several years. It still addresses the procedures and guidelines to be used for forward discharge lighting systems. Forward discharge lighting systems consist of low beam headlamps and high beam headlamps.

### *1. Scope*

This SAE Recommended Practice applies to motor vehicle forward illumination systems and subsystems generated by discharge sources. It provides test methods, requirements, and guidelines applicable to the special characteristics of gaseous discharge lighting devices which supplement those required for forward illumination systems using incandescent light sources. The document is applicable to both discharge forward lighting systems, subsystems and components. This document is intended to be a guide to standard practice and is subject to change to reflect additional experience and technical advances.

### 1.1 Rationale

The J2009 document has been revised to reflect industry changes in the last five to seven years. In an attempt to support further worldwide harmonization, several tests and requirements have been aligned with ECE regulations, especially ECE R98 and R99 and IEC regulations, especially IEC 60810.

Many manufacturers have produced DFL systems and the field experience gathered has allowed the further advancement of specifications in the area of photometry, maintenance and color. These advancements are captured in this revised document. Several references have been added where additional information has been derived and as the systems continue to develop, more data will be accumulated and the specifications refined. The document remains a recommended practice for the use of low and high beam forward lighting systems. The addition of other forward lighting devices such as daytime running light (DRL), cornering lamp and fog lamp will be considered in future revisions of the document as these devices become more widely used in the industry. The specifications outlined in SAE J2009, written with the automotive industry input, will continue to serve in conjunction with federal regulations in the hope that they will become the standard referenced in future federal regulation changes.

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These are changes to the following sections and guidelines:

2. References – References to the revised document have been updated to reflect new changes. This includes references both directly and related to the J2009 document.

3. Definitions – Definitions have been revised to be consistent with new changes.

4.4 Notices/Labeling – Manufacturers of devices that may be hazardous in normal use, operation or service have a duty to warn of such hazards if such hazards cannot reasonably be designed out of the product. Such warnings should comply with applicable standards, such as ANSI Z535.4. Additionally, some materials have restricted use and/or labeling requirements for components and/or vehicles, (specific references) and the manufacturers of devices containing such substances may have to provide information to the original equipment manufacturer and/or on the device to meet government mandated labeling requirements.

5. Seasoning and Stabilization – In order to provide a stable light output during the period of the test, light sources shall be seasoned. Because the light output of discharge forward lighting may vary during the period of thermal stabilization of the system, tests shall be done after an appropriate time of stabilization. The Initial start up behavior is addressed in dedicated tests.

5.1 and 5.3 Photometry – The photometry procedure and requirements were separated into component and system sections. It was determined that the light source should meet the “standard” requirements as outlined in Table 1 and when tested with an adjustable wattage ballast per Table 1, the system shall meet the photometric system requirements of J1383. Because a DFL system output will vary with wattage as a tungsten filament will change with voltage, the “rated” system is measured to a rated wattage (Table 1) and then measured in the system optical assembly. The various versions of DFL light sources were added to Table 1 and reflect the industry sources identified in Part 564 of FMVSS 108. Seasoning was added due to fluctuations in the discharge capsule during initial ageing of the light source. Once a stabilized output has been achieved (relatively constant spherical flux for ten to 20 hours), the source has been adequately aged. This is typically about 1 percent of the laboratory design life of the source.

5.4. System Starting – The system starting requirements have been established through various field tests and production experience by the system manufacturers and vehicle manufacturers. The requirements have been refined to reflect this knowledge and experience. Studies have been performed and in particular a study of “Rise-Time Requirements For High-Intensity Discharge Headlamps” – UMTRI-2001-14, University of Michigan Transportation Research Institute, was used to confirm the performance criteria established in this document. Field experience and studies with European manufacturers also confirm the performance of system starting for discharge headlamp systems.

The steady state requirement in ECE R98 for low beam is 12 lx, during run-up is 10 lx is required after 4 seconds, FMVSS requires 15 000cd, therefore 10 000 cd should be appropriate. For high beam ECE R98 requires 70 lx in steady state conditions and 60 lx during run-up after 4 seconds. FMVSS requires 45 000 cd, thus 30 000 cd after 4 seconds should be appropriate, non-continuous accordingly.



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5.4.3 Hot restrike – The DFL system shall be switched off for the period of time indicated in Table 4 in order to simulate momentary switching to the alternate beam or erroneously switching of the lighting during driving.

5.5 Red spectral content – It is required that the spectral power distributions of DFL systems produce adequate color rendering to interpret road signs and markings. This implies that some portion of light should be present in the system output across the visual spectrum. This is particularly true in the long wavelength region (610 nm - 780 nm where some discharge sources may be deficient.

5.6 Color in beam pattern – It is also required that light from DFL systems be perceived as white as defined by SAE J578. The white color of DFL systems is presumed to exhibit only minor localized variations from the integrated measurement. Use of the CRI metric does not ensure that sufficient light exists in this region to ensure red objects are rendered red. Therefore the use of a mandatory spectral content method was adopted. No significant color variation should exist within the projected light beam when the device is energized over the life of the DFL system.

5.7 Ultraviolet Energy – The combination of UV light and moisture generated accelerated degradation of plastic headlamp lenses, if they were not properly protected. Initially, the effect was found with halogen bulbs using quartz capsules. These capsules were transparent to UV radiation in contrary to the hardglass capsules used for certain other halogen bulb types.

First gas discharge bulbs used only pure quartz arc tubes without outer bulb. Since the discharge tubes are also transparent to UV radiation, an additional filter UV filter tube had to be applied. The UV requirement was simultaneously introduced for halogen and discharge bulbs.

Additionally, concerns about health supported the introduction of UV free bulbs.

5.8 Life – A common life test failure mode is failure of the quartz to metal seal in the press area of the arc tube. The stress on this seal during life test is temperature dependent. It is recommended in the guidelines that life testing of HID light sources be performed in enclosures sized to provide a temperature of approximately 400 degrees Celsius in the press area of the arc tube after 20 minutes of operation. In this way testing will be more consistent and comparable between laboratories.

5.9 Environmental Tests – Environmental conditions such as temperature, humidity, moisture, dust and chemical substances can negatively affect the performance of forward lighting devices. Appropriate tests to prove the robustness of the devices are defined in the applicable device standards. Additionally, SAE J2357 addresses specifically devices operated with electrical control modules. These tests are referenced in the environmental test section.

5.12 Light Source Deflection – Light source deflection was added to the new set of requirements. It is recognized that the light source may experience some handling stress before installation. And, photometric performance of lighting systems is sensitive to the light source location. The bulb deflection test sets a standard for bulb resistance to handling stress. Although the 18 Newton force is quite severe this test and requirements reflect the requirement in FMVSS 108.



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