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SURFACE VEHICLE RECOMMENDED PRACTICE

SAE J2282

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(R) Distributed Lighting Systems (DLS)

1. ***Scope—***This SAE Recommended Practice applies to motor vehicle Distributed Lighting Systems (DLS) which use light generated by remote sources. It provides test methods, requirements, and guidelines applicable to these systems. This document is intended to be a guide to standard practice and is subject to change dependent upon additional experience and technical advances. This document covers Headlamp, Fog lamp, Auxiliary lamp, plus Signal and Marking lamp functions.

2. ***References***

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

2.1.1 SAE PUBLICATIONS—available from SAE, 400 Commonwealth Drive, Warrendale, PA. 15096-0001.

SAE J575—Test Methods and Equipment for Lighting Devices and Components for use on Vehicles Less than 2032 mm in Overall Width
SAE J578—Color Specification
SAE J583—Front Fog Lamps
SAE J759—Lighting Identification Code
SAEJ1113-1—Electromagnetic Compatibility Measurement Procedures for Vehicle Components (Except Aircraft) (60Hz to 18GHz)
SAE J1113-2—Electromagnetic Compatibility Measurmen Procedures and Limits for Vehicle Components (Except Aircraft)—Conducted Immunity, 30 Hz to 250 kHz—All Leads
SAEJ1113-3—Conducted Immunity, 250 kHz to 5000 MHz, Direct Injection of Radio Frequency (RF) Power
SAE J1113-4—Immunity to Radiated Electromagnetic Fields—Bulk Current Injection (BCI) Method
SAE J1113-11—Immunity to Conducted Transients on Power Leads
SAEJ1113-13—Electromagnetic Susceptibility Measurement Procedures for Vehicle Components—Part 13: Electrostatic Discharge
SAEJ1113-21—Road Vehicles—Electrical Disturbances By Narrowband Radiated Electromagnetic Energy—Component Test Methods—Part 21: Absorber Lined Chamber
SAEJ1113-22—Electromagnetic Compatibility Measurement Procedure for Vehicle Components—Part 22: Immunity to Radiated Magnetic Fields From Power Lines
SAEJ1113-23—Electromagnetic Compatibility Measurement Procedure for Vehicle Components—Part 23: Immunity to Radiated Electromagnetic Fields, 10 kHz to 200 MHz, Stripline Method
SAEJ1113-24—Electromagnetic Compatibility Measurement Procedure for Vehicle Components—Part 24: Immunity to Radiated Electromagnetic Fields, 10 kHz to 200 MHz, TEM Cell Method

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SAEJ1113-25—Electromagnetic Compatibility Measurement Procedure for Vehicle Components—Part 25: Immunity to Radiated Electromagnetic Fields, 10 kHz to 200 MHz—Tri-Plate Method
SAEJ1113-27—Electromagnetic Compatibility Measurements Procedure for Vehicle Components—Part 27: Immunity to Radiated Electromagnetic Fields
SAEJ1113-41—Limits and Methods of Measurement of Radio Disturbance Characteristics of Components and Modules for the Protection of Receivers used On Board Vehicles
SAEJ1113-42—Electromagnetic Compatibility—Component Test Procedure—Part 42: Conducted Transient Emissions
SAE J1211—Recommended Environmental Practices for Electronic Equipment Design
SAE J1383—Performance Requirements for Motor Vehicle Headlamps
SAE J1889—L.E.D. Lighting Devices
SAE J2009—Discharge Forward Lighting System
SAE J2139—Test for Lighting Devices and Components used on Vehicles 2032 mm or More in Overall Width
SAE J2320—Discharge Signal Lighting System
SAE J2357—Application Guidelines for Electronically Driven and/or Controlled Exterior Automotive Lighting Equipment

2.2 Related Publications—The following publications are provided for information purposes only and are not a required part of this specification.

2.2.1 ANSI PUBLICATION—Available from ANSI, 25 West 43rd Street, New York, NY 10036-8002.

ANSI C78.376-1996—Specifications for the Chromaticity of Fluorescent Lamps

2.2.2 CIE PUBLICATION—Available from Commission Internationale de L'eclairage, 52 Bd Malesherbes, F-75008 Paris, France.

CIE Publication 13.2—Method of Measuring and Specifying Color Rendering

3. Definitions

3.1 Photometric Maintenance—Change in luminous intensity of the test points of the beam pattern over time.

3.2 Life—Time in hours and starting cycles of a DLS during which it meets specified operational characteristics.

3.3 Rated Laboratory Life—Specified by the manufacturer as the period of time during which the DLS meets the performance specifications.

3.4 Color CRI—Measure of the degree of color shift objects undergo when illuminated by the light source as compared with the color of those same objects when illuminated by a reference source of comparable color temperature.

3.5 Distributed Lighting System (DLS)—A system that transmits light from a remote source to one or more lighting function(s).

3.6 Leakage current breakdown—An electronic measurement technique used on electronic devices/modules to determine if a final current (amps) measurement differs from an initial current (amps) measurement by a defined value. The resulting measurement indicates whether a breakdown in the electrical circuit has occurred causing the current (amps) level to change after exposure to a durability or environmental test procedure.

3.7 With controls—Any mechanical or electrical device that effects the DLS state other then the manually activated on/off switch."

4. Lighting Identification Codes, Markings and Notices

4.1 Lamps may be marked in accordance with SAE J759.

4.2 A DLS containing High Voltage Components shall be marked to indicate the presence of high voltage, e.g., the ISO electric shock hazard symbol ("lightning bolt") where applicable.

5. ***Tests—***Sample systems shall be seasoned per the SAE standards applicable for the light source employed by the DLS prior to being subjected to the tests below. A separate DLS may be used for each test. Testing shall be accomplished on a complete system (i.e., light source, interconnections, and lamp) as required unless otherwise specified in the specific test. If "orientation" affects the performance of any component, the component shall be maintained in its design orientation throughout the test. A system component shall be tested to the most severe condition the specific component would be subjected to in application –(e.g., under hood conditions if it passes through the under-hood region). See Table 1.

NOTE— The power supply of a distributed lighting system that employs a ballast shall have its output isolated from the input to prevent any potential danger to laboratory personnel when running tests as required.

TABLE 1—DLS LAMP FUNCTIONS AND TYPES

FUNCTION	TEST GROUP
HEADLAMP (A)	A1 = DISCHARGE SOURCE
	A2 = INCANDESCENT SOURCE
	A3 = INCANDESCENT w/Controls
FOG/AUX. LAMP (B)	B1 = DISCHARGE SOURCE
	B2 = INCANDESCENT SOURCE
	B3 = INCANDESCENT w/Controls
SIGNAL /MARKING (C)	C1 = DISCHARGE SOURCE
	C2 = INCANDESCENT SOURCE
	C3 = INCANDESCENT w/controls
	C4 = DISCHARGE w/controls
	C5 = LED SOURCE

5.1 Lamp/System Starting Procedures—The lamp shall be held in its vehicle operating position and aimed per the appropriate SAE standard. Tests shall be conducted at room temperature (23 °C ± 3 °C), at design voltage ±0.1 V DC, and for a duration required to obtain a reading. The response time of the measurement instrument shall be less then 100 ms.

5.1.1 INITIAL START-UP—Systems shall be tested as follows:

Group A1, A3, B1, B3:	SAE J2009 Initial Start-Up
Group A2, B2, C2, C5:	Not applicable
Group C1, C3, C4:	SAE J2320 Light rise up-time

5.1.2 SWITCHING (OF BEAMS)—Systems shall be tested as follows:

Group A1, A3, B1, B3:	SAE J2009 Switching
Group A2, B2, C2, C5:	Not applicable
Group C1, C3, C4:	SAE J2320 Light rise-up time

5.2 Electrical Characteristics

5.2.1 SYSTEM OPERATING WATTAGE RANGE—The DLS shall be tested as follows:

Group A1, B1:	SAE J2009 Operating Wattage
Group A2, A3:	SAE J1383 Operating Wattage
Group B2, B3, C1,C2, C3, C4, C5:	Not applicable

5.2.2 SYSTEM OPERATING VOLTAGE RANGE—Systems shall be tested as follows:

Group A1, B1:	SAE J2009 Operating Voltage
Group A2, A3, B2, B3:	Not applicable
Group C1, C4:	SAE J2320 Operating Voltage
Group C2, C3:	SAE J2357 Operating Voltage
Group C5:	SAE J1889 Operating Voltage

5.2.3 TEST EQUIPMENT REQUIREMENTS—Test equipment shall conform to the following requirements:

Group A1, B1:	SAE J2009 Equipment Requirements
Group A2, A3, B2, B3, C2:	Not applicable
Group C1, C3, C4, C5:	SAE J2320 Equipment Requirements

5.3 Source Photometric Maintenance—Sources shall be tested in a system as follows:

Group A1:	SAE J2009 Photometric Maintenance
Group A2, A3:	SAE J1383 Photometric Maintenance
Group C1, C4:	SAE J2320 Photometric Maintenance
Group B1, B2, B3, C2, C3, C5:	Not Applicable

5.4 Color and CRI—Systems shall be tested as follows:

5.4.1 COLOR

Group - All:	The color coordinates shall be tested per SAE J578 for the applicable function

5.4.2 COLOR RENDERING INDEX (CRI - SOURCE FOR "WHITE LIGHT" APPLICATIONS ONLY):

Group A1, B1:	Systems shall be tested per SAE J2009 Color Rendering.
Group - All Other:	Not applicable.

5.5 Leakage Current/Breakdown Test—Systems shall be tested as follows:

Group A1,B1,C1,C4:	System electric components shall be tested per SAE J2009 Leakage
Group A2,A3,B2,B3,C2,C3,C5:	Not applicable.

5.6 Thermal Cycle—The DLS shall be mounted on a test fixture in its design orientation.

5.6.1 The lamp portion of the DLS shall be tested as follows:

Group A1:	SAE J2009 Thermal Cycle
Group A2:	SAE J1383 Thermal Cycle
Group A3,B1,B3:	SAE J2357 Thermal Cycle
Group B2,C1,C2,C3,C4:	Test to applicable SAE Lamp or System Device Standard
Group C5:	SAE J1889 Thermal Cycle

5.6.2 All DLS components (including the source) shall be Thermal Cycle tested as specified in SAE J2357 for the DLS component location on the vehicle.

5.7 Humidity/Moisture—The DLS shall be mounted on a test fixture in its design orientation.

5.7.1 The lamp portion of the DLS shall be tested as follows:

Group A1:	SAE J2009 Humidity
Group A2:	SAE J1383 Humidity
Group A3,B1,B3,C3:	SAE J2357 Humidity
Group B2:	SAE J583
Group C1,C4:	SAE J2320 Intended Lighting Function Testing
Group C2:	Test to applicable SAE Lamp Standard
Group C5:	SAE J1889 Moisture

5.7.2 All DLS components (including the source) shall be tested by either Humidity, Immersion, or splash testing as specified in SAE J2357 for the DLS component location on the vehicle.

5.8 Internal Heat—(Applicable only for Lighting Devices that contain a Distributive Lighting Source.)

5.8.1 The DLS shall be mounted on a test fixture in its design orientation.

Group A1:	Tested per SAE J2009 Internal Heat and at test conclusion test device to SAE J2009 “Color” test
Group A2,A3:	Device shall be tested per SAE J1383 Internal Heat (as appropriate)
Group B1,B2,B3:	Device shall be tested per SAE J583
Group C1,C2,C3,C4,C5:	Not applicable

5.9 Sand, Dust, and Gravel Test—The DLS shall be mounted on a test fixture in its design orientation.

5.9.1 The lamp portion of the DLS shall be tested as follows:

Group A1:	SAE J2009 Dust test
Group A2, A3:	SAE J1383 Dust test
Group B1,B2,B3,C3:	SAE J575 Dust test (Option: Use SAE J2139 for Heavy Duty applications)
Group C1,C4:	SAE J2320 Intended Lighting Function Testing
Group C2:	Test to applicable SAE Lamp Standard
Group C5:	SAE J1889 Dust test

5.9.2 All other DLS components shall be subjected to the Sand, Dust or Gravel testing as applicable and as specified in SAE J575 for the DLS component location on the vehicle test. (Option: Use J2139 for Heavy Duty applications.)

5.9.2.1 *Dust Test*—For components containing a discharge light source, ballast or other electronic or electrical components the dust test shall be in accordance with SAE J2009 Dust test. For all other DLS components the dust test shall be in accordance with SAE J575 Dust test. (Option: Use J2139 for Heavy Duty applications.)

5.9.2.2 *Sand Test*—For DLS segments which contain mechanical components the sand exposure test shall be conducted in accordance with SAE J575 Dust test. (Option: Use J2139 for Heavy Duty applications.)

5.9.2.3 *Gravel Test*—For DLS segments other than light emitting surfaces the gravel bombardment test shall be conducted in accordance with SAE J575 Dust test. (Option: Use J2139 for Heavy Duty applications.)

5.10 Corrosion Test—The DLS shall be mounted in its design orientation.

5.10.1 The lamp portion of the DLS shall be tested as follows:

Group A1:	SAE J2009 Corrosion test
Group A2:	SAE J1383 Corrosion test
Group A3,B1,B3,C3:	SAE J2357 Corrosion test
Group B2:	SAE J583 Corrosion test
Group C1,C4:	SAE J2320 Intended Lighting Function Testing
Group C2:	Test to applicable SAE lamp Standard
Group C5:	SAE J1889 Corrosion test

5.10.2 All other components of the DLS shall be tested as specified in SAE J2357. The DLS component shall be operating or non-operating as defined by the user.

5.11 Chemical Resistance Test—The DLS shall be mounted on a test fixture in its design orientation.

5.11.1 The lamp portion of the DLS shall be tested as follows:

Group A1:	SAE J2009 Chemical Resistance
Group A2:	SAE J1383 Chemical Resistance
Group A3,B1,B3,C3:	SAE J2357 Chemical Resistance test
Group B2:	SAE J583 Chemical Resistance
Group C1,C4:	SAE J2320 Intended Lighting Function Testing
Group C2, C5:	Test to applicable SAE lamp standard

5.11.2 All other components of the DLS shall be tested by selecting applicable chemicals from Figure 1 based on the DLS components location on the vehicle. Brush the specified chemical solutions onto the DLS and then hold the DLS at the specified temperature shown in Figure 1 for 96 hours.

5.12 Vibration Test—The DLS shall be mounted on a test fixture in its design orientation.

5.12.1 The lamp portion of the DLS shall be tested as follows:

Group A1:	SAE J2009 Vibration
Group A2,C2:	SAE J575 Vibration (Option: Use J2139 For Heavy Duty applications)
Group A3,B1,B3,C3:	SAE J2357 Vibration test
Group B2:	SAE J583 Vibration test
Group C5:	SAE J1889 Vibration test
Group C1,C4:	SAE J2320 Intended Lighting Function Testing

5.12.2 All other DLS components shall be vibration tested as specified in SAE J2357 for the DLS component location on the vehicle. Components may be grouped per the manufacturer's discretion.

5.13 Altitude Test

5.13.1 The DLS shall be tested as follows:

Group A1, A3:	Test per SAE J2009 Altitude test.
Group A2,B1,B2,B3,C1,C2,C3,C4,C5:	Applicable tests

5.13.2 All other DLS electronic components shall be tested to SAE J1211 Altitude Test with "DLS" replacing "system" and the Breakdown test in 5.5. For "operating" test in SAE J1211, subject DLS to the same total number hours testing as specified in the Thermal Cycle Test using T-min as operating temperature. (Option: Run test in conjunction with thermal cycle test). For "nonoperating" test in SAE J1211, subject DLS to 2X total hours as specified in the Thermal Cycle Test at –40 °C operating temperature.

5.14 Photometry—(Use Accurate Rated Source – or as referenced in applicable standard):

Group A1:	Systems shall be tested per SAE J2009 Photometry.
Group A2,A3:	Systems shall be tested per SAE J1383 Photometry.
Group B1,B2,B3;	System tested to SAE J583 Photometry
Group C1,C2,C3,C4,C5:	Tested to appropriate SAE standard for lamp function.

5.15 Electromagnetic Compatibility (EMS and EMR)—The DLS will incorporate the appropriate fixture and components necessary to perform the electromagnetic compatibility tests as outlined. When specified, the DLS will be fixtured to attain design orientation of all components comprising the system.

5.15.1 The DLS shall be tested to the appropriate sections of SAE J1113 (as applicable to the particular type of system being tested) and according to the following:

Group A1,A3,B1,B3,C1,C3,C4,C5:	Tested to SAE J2357
Group A2,B2,C2:	Not applicable

5.15.2 Other DLS electronic components shall be tested to the appropriate sections:

Group A3,B3,C3,C4,C5:	Tested to SAE J2357

6. Performance Requirements

6.1 Lamp/system Starting Procedures

6.1.1 INITIAL START-UP—Systems shall conform to the following:

Group A1, A3, B1, B3:	SAE J2009 Initial Start-Up
Group A2,B2,C2,C5:	Not applicable
Group C1,C3, C4:	SAE J2320 Light rise-up time

6.1.2 SWITCHING (OF BEAM)—Systems shall conform to the following:

Group A1, A3, B1, B3:	SAE J2009 Switching
Group A2, B2, C2,C5:	Not applicable
Group C1,C3, C4:	SAE J2320 Light rise-up time

6.2 Electrical Characteristics

6.2.1 SYSTEM OPERATING WATTAGE RANGE—The DLS shall meet the following requirements:

Group A1, B1:	SAE J2009 Operating Wattage
Group A2, A3:	SAE J1383 Operating Wattage
Group B2,B3,C1,C2,C3,C4,C5:	Not applicable

6.2.2 SYSTEM OPERATING VOLTAGE RANGE—Systems shall meet the following requirements:

Group A1,B1:	SAE J2009 Operating Voltage
Group A2,A3,B2,B3:	Not applicable
Group C1,C4:	SAE J2320 Operating Voltage
Group C2,C3:	SAE J2357 Operating Voltage
Group C5:	SAE J1889 Operating Voltage

6.3 Source Photometric Maintenance—Systems shall meet the following requirements:

Group A1:	SAE J2009 Photometric Maintenance plus meet 6.4 “Color” after testing
Group A2,A3:	SAE J1383 Photometric Maintenance plus meet 6.4 “Color” after testing
Group C1,C4:	SAE J2320 Photometric Maintenance
Group B1,B2,B3,C2,C3,C5:	Not Applicable

6.4 Color (and CRI)

NOTE— SAE J1383 and SAE J578 are a part of this document.

6.4.1 COLOR

Group – All:	The color coordinates shall meet the requirements of SAE J578 for the applicable function

6.4.2 COLOR RENDERING INDEX FOR CRI.

Group A1,B1:	See Guidelines 7.7
Group -All Other:	Not applicable

6.5 Leakage Current/Breakdown Test:—Systems shall meet the following requirements:

Group A1, B1, C1, C4:	System electrical components shall meet the requirements of SAE J2009 Leakage
Group A2,A3,B2,B3,C2,C3,C5:	Not applicable

6.6 Thermal Cycle

6.6.1 The lamp portion of the DLS shall meet the following requirements:

Group A1:	SAE J2009 Thermal Cycle plus meet 6.4 “Color” after testing
Group A2:	SAE J1383 Thermal Cycle plus meet 6.4 “Color” after testing
Group A3,B1,B3:	SAE J2357 Thermal Cycle
Group B2,C1,C2,C3,C4:	The applicable SAE lamp or System Device standard
Group C5:	SAE J1889 Thermal Cycle

6.6.2 The manufacturer must insure that all other DLS components shall operate after the test. The system shall have no visible signs of deterioration, or damage. All DLS components (including the source) shall meet the Thermal Cycle requirements as specified in SAE J2357 for the DLS component location on the vehicle.

6.7 Humidity/Moisture Test

6.7.1 The lamp portion of the DLS shall meet:

Group A1:	SAE J2009 Humidity plus meet 6.4 “Color” after testing.
Group A2:	SAE J1383 Humidity plus meet 6.4 “Color” after testing.
Group A3,B1,B3,C3:	SAE J2357 Humidity.
Group B2:	SAE J583
Group C1, C4:	SAE J2320 Intended Lighting Function Testing
Group C2:	The applicable SAE Lamp Standard
Group C5:	SAE J1889 Moisture

6.7.2 The manufacturer must insure that all other DLS components shall operate after the test. The system shall have no visible signs of deterioration, or damage. All other DLS components (including the source) shall meet the requirements of either Humidity, Immersion, or splash as specified in SAE J2357 for the DLS component location on the vehicle.

6.8 Internal Heat—(Applicable only for Lighting Devices that contain a Distributive Lighting Source.)

Systems shall meet the following requirements:

Group A1:	SAE J2009 Internal Heat and at test conclusion test device to SAE J2009 “Color” test
Group A2:	A3 SAE J1383 Internal Heat (as appropriate)
Group B1, B2, B3:	SAE J583
Group C1, C2, C3, C4, C5:	Not applicable

6.9 Sand, Dust, and Gravel Test

6.9.1 The lamp portion of the DLS shall meet the following requirements:

Group A1:	SAE J2009 Dust
Group A2, A3:	SAE J1383 Dust
Group B1,B2,B3,C3:	SAE J575 Dust test (Option: Use SAE J2139 for Heavy Duty applications)
Group C1,C4:	SAE J2320 Intended Lighting Function Testing
Group C2:	Requirements of applicable SAE Lamp Standard
Group C5:	SAE J1889 Dust test

6.9.2 Lamp manufacturer must insure that all other DLS components shall operate after the test.

The system shall have no visible signs of deterioration, or damage. Components subjected to the Sand, Dust or Gravel testing shall meet the applicable requirements as specified in SAE J575 Dust test for the DLS component location on the vehicle. (Option: Use SAE J2139 for Heavy Duty applications.)

6.9.2.1 Dust test—Components containing a discharge light source, ballast or other electronic or electrical components shall meet the requirements of SAE J2009 Dust test. All other DLS components shall meet the requirements of SAE J575 Dust test. (Option: Use SAE J2139 for Heavy Duty applications.)

6.9.2.2 *Sand Test*—DLS segments which contain mechanical components shall meet the requirements of sand exposure in SAE J575 Dust test. (Option: Use SAE J2139 for Heavy Duty applications.)

6.9.2.3 *Gravel test*—DLS segments other than light emitting surfaces shall meet the requirements of the gravel bombardment specified in SAE J575 Dust test. (Option: Use SAE J2139 for Heavy Duty applications.)

6.10 Corrosion Test

6.10.1 The lamp portion of the DLS shall meet:

Group A1:	SAE J2009 Corrosion plus meet 6.4 “Color” after testing
Group A2:	SAE J1383 Corrosion plus meet 6.4 “Color” after testing
Group A3,B1, B3, C3:	SAE J2357 Corrosion test
Group B2:	SAE J583 Corrosion test
Group C1, C4:	SAE J2320 Intended Lighting Function Testing
Group C2:	Test to applicable SAE lamp Standard
Group C5:	SAE J1889 Corrosion test

6.10.2 All other DLS components shall meet the requirements as specified for corrosion in SAE J2357 for the DLS location on the vehicle. Also the DLS component shall operate properly throughout the test. After completing the test there shall be no significant change in performance or visible signs of deterioration or damage.

6.11 Chemical Resistance Test

6.11.1 The lamp portion of the DLS shall meet:

Group A1:	SAE J2009 Chemical Resistance plus meet 6.4 “Color” after testing
Group A2:	SAE J1383 Chemical Resistance plus meet 6.4 “Color” after testing
Group A3,B1,B3,C3:	SAE J2357 Chemical resistance test
Group B2:	SAE J583 Chemical resistance
Group C1, C4:	SAE J2320 Intended Lighting Function Testing
Group C2, C5:	Applicable SAE Lamp Standard Chemical resistance

6.11.2 ALL OTHER DLS COMPONENTS—After completing the test there shall be no significant degradation in performance or visible signs of deterioration or damage.

6.12 Vibration Test

6.12.1 The DLS lamp portion shall meet the requirements of applicable sections in the SAE standards noted:

Group A1:	SAEJ2009 Vibration
Group A2, C2:	SAE J575 Vibration test (Option: Use SAE J2139 for Heavy Duty applications)
Group A3,B1,B3, C3:	SAE J2357 Vibration test
Group B2:	SAE J583 Vibration test
Group C5:	SAE J1889 Vibration test
Group C1,C4:	SAE J2320 Intended Lighting Function Testing

6.12.2 All other DLS components shall meet the vibration requirements as specified in SAE J2357 for the DLS component location on the vehicle. Components may be grouped per the manufacturers discretion.

6.13 Altitude Test

6.13.1 The DLS shall meet the following requirements:

Group A1,A3:	System shall meet SAEJ2009 altitude test requirements
Group A2,B1,B2,B3,C1,C2,C3,C4,C5:	The appropriate SAE standard for lamp function

6.13.2 The system's electronics shall comply with the applicable requirements of SAE J1211 Altitude Test. There shall be no evidence of breakdown during the Breakdown Test. In addition, electronic components shall meet the requirements of SAE J1211 using conditions that are appropriate for the location of the system components in the vehicle.

6.14 Photometry—The system shall meet the requirements as specified in the SAE standards noted:

Group A1:	SAE J2009 Photometry
Group A2,A3:	SAE J1383 Photometry (as appropriate).
Group B1,B2,B3:	SAE J583
Group C1,C2,C3,C4,C5:	The appropriate SAE standard for lamp function

6.15 Electromagnetic Compatibility (EMS and EMR)

6.15.1 The DLS shall meet the requirements of the applicable sections of SAE J1113 (as applicable to the particular type of system being tested) and according to the following standard:

Group A1,A3,B1,B3,C1,C3,C4,C5:	SAE J2357 EMS and EMR
Group A2,B2,C2:	Not applicable

6.15.2 DLS electronic components of Groups noted below shall meet the requirements of applicable SAE sections:

Group A3,B3,C3,C4,C5:	Meet SAE J2357 EMS and EMR

7. Guidelines

7.1 Colorimetric Characteristics—The colorimetric characteristics or color rendering index (CRI) shall meet the general criterion of General Rendering Index (Ra) = 60. Each source manufacturer and user shall determine that the light produced shall readily allow the customer to distinguish between typical road sign colors.

7.1.1 MINIMUM RED CONTENT—The red content, k_{red}, of the light from the source emitting white light shall be such that:

$$k_{red} = \frac{\int_{\lambda=610nm}^{780nm} E(\lambda)\,v(\lambda)\,d\lambda}{\int_{\lambda=380nm}^{780nm} E(\lambda)\,v(\lambda)\,d\lambda} \geq 0.05 \qquad \text{(Eq. 1)}$$

where

E(λ) [W/area/nm] is the spectral irradiance
v(λ) is the spectral luminous efficiency function
λ [nm] is the wavelength

7.2 Life—Following operation per SAE J2009 or SAE J1383 to 70% of rated life.

Group A1:	Systems shall meet the guidelines of SAE J2009
Group A2, A3:	Systems shall meet the guidelines of SAE J1383
Group All other:	Applicable standards

7.3 System Reliability—The following Guidelines apply when all Low Beam contributors operate off a single Light Source. This does not apply to Low Beam systems that have more than one Light Source.

7.3.1 SYSTEM STATUS RECOMMENDATIONS

7.3.1.1 The distributive headlighting system design shall provide an immediate visual and/or audible indication to the operator that an outage of the distributive lighting source has occurred (such as a telltale in the instrument cluster).

7.3.1.2 The distributive lighting system design shall provide exterior Marking Lamp functions that are maintained even if the distributive lighting source becomes inoperative.

7.3.2 SYSTEM FUNCTIONAL GUIDELINES—The vehicle Marking Lamp functions shall be maintained even if the DLS headlamps become inoperative."

7.4 Steady State

Group A1:	Systems shall follow the guidelines of SAE J2009
Group All others:	Not applicable

7.5 High Voltage Shock Safety

Group A1:	Systems shall follow the guidelines of SAE J2009
Group All other:	Not applicable

7.6 High Voltage Vapor Ignition Safety

Group A1:	Systems shall follow the guidelines of SAE J2009
Group All Others:	Not applicable

7.7 Color Rendering Index (CRI) (Source only)

Group A1, B1:	Systems shall follow the guidelines of SAE J2009
Group All others:	Not applicable

7.8 System Operating Voltage Range

Group A1:	Systems shall follow the guidelines of SAE J2009
Group All others:	Not applicable

7.9 Ice and Snow—Since a DLS headlamp may operate at a lower temperature than a halogen based headlighting system, consideration should be made in the design of the lamp to optimize snow and ice performance. The following recommendations are offered:

a. The headlamp should be designed with maximum flushness to surrounding surface to facilitate self cleaning of the lamp.
b. Apply lens coatings that would not be damaged by ice scrapers.
c. Provide a washer system that would effectively remove snow build-up.

d. Provide defrosting capability on the lens. For example, this capability could be a spray de-icer or built-in heaters/defrosters similar to those used on rear window or outside mirrors.

Description of Location in Vehicle			Temp °C	List of Chemicals
Zone 1 - Under Hood (Engine Compartment)	Away from Heat Source	Well ventilated with cool air from outside engine compartment	95	1. Engine oil 2. Transmission fluid 3. Brake fluid (near brake & ABS systems) 4. Coolant 5. Window washer fluid 6. Grease 7. Soap for cleaning engine compartment 8. Battery acid (near the battery only) 9. Clear Lacquer 10. CaCl2 (Calcium Chloride) 11 Power steering fluid 12. Degreasers 13. Steam 14. Freon 15. Ether
		Well ventilated	115	
	Near heat source		150	
Zone 2 - Body Exterior (Lower Exterior Body and Underbody, Upper Exterior Body)	Outer Body Exterior (including bumpers, side view mirrors, roof etc.)		85	1. Kerosene 2. Fuel (including gasoline, methanol, etc.) 3. Leather wax 4. Car wax and silicone protectants 5. Window glass cleaner 6. Car wash soap 7. Window washer fluid 8. Damper oil (near air suspension valve or height control system) 9. CaCl2 (Calcium Chloride) 10. Undercoating materials 11. Rear axle oil 12. Axle grease 13. Vinyl plasticizers
	Under-body (including Suspension)	Near Trans. or Differential	125	
		Drivetrain - High Temp	177	
		Away from heat source	85	
		Near exhaust (with protection)	150	
	Near Brake Pad/Rotor			
Zone 3 - Body Interior	Package Tray		107	1. Leather Wax 2. Anti-mist spray 3. Soap for cleaning 4. De-odorizer spray 5. Coffee, tea, cola, etc. 6. Vinyl plasticizers
	Floor-Passenger Compartment	Near (underbody) heat source	115	
		Away from (underbody) heat source	85	
	Instrument Panel	Front	85	
		Top	115	
	Luggage Compartment (Trunk)	Away from (underbody) heat source	85	1. Engine oil 2. Coolant 3. Window washer fluid 4. Grease 5. Battery acid (near battery only) 6. Kerosene 7. Fuel (near fuel filler door) 8. Window glass cleaner 9. Cleaning soap
		Near (underbody) heat source	115	
	Door Interiors	Near top (in upper areas heated by sunlight)	105	1. Undercoating materials
		Mid and lower portions	85	

FIGURE 1—CHEMICAL RESISTANCE TESTING AND ZONAL TEMPERATURE REQUIREMENT

8. Notes

8.1 Marginal Indicia—The change bar (l) located in the left margin is for the convenience of the user in locating areas where technical revisions have been made to the previous issue of the report. An (R) symbol to the left of the document title indicates a complete revision of the report.

PREPARED BY THE SAE INTERNATIONAL DISTRIBUTED LIGHTING TASK FORCE OF THE SAE ROAD ILLUMINATION DEVICES STANDARD COMMITTEE

SAE J2282 Revised APR2002

Rationale—Changes are as follows:

1. Scope

The initial SAE J2282 was published as a RECOMMENDED PRACTICE for motor vehicle headlamp functions only. The Recommended Practice applied to motor vehicles which utilized a Distributed Lighting System (DLS) to power both headlamps with light generated by a single remote source. That document has now been revised to address vehicles where all exterior lighting functions can employ a Distributed Lighting System(s) (DLS) that use light generated by a single or multiple remote sources. This document provides applicable test methods, requirements, and guidelines for systems as noted below.

SAE Standard	FUNCTION	TEST GROUP
SAE J2282	HEADLAMP (A)	A1 = DISCHARGE SOURCE
		A2 = INCANDESCENT SOURCE
		A3 = INCANDESCENT w/Controls
	FOG/AUX. LAMP (B)	B1 = DISCHARGE SOURCE
		B2 = INCANDESCENT SOURCE
		B3 = INCANDESCENT w/Controls
	SIGNAL /MARKING (C)	C1 = DISCHARGE SOURCE
		C2 = INCANDESCENT SOURCE
		C3 = INCANDESCENT w/controls
		C4 = DISCHARGE w/controls
		C5 = LED SOURCE

5.2 Electrical Characteristics

5.2.1 System Operating Wattage

Wattage is an important parameter for devices/systems which are current controlled through a power regulator (ballast). The controlling parameters of the light source are influenced by this power control, thus any deviations/fluctuations measured before/after a test are critical to the overall performance of the device. It is for these reasons that the particular lamp types have been designated in 5.2.1 for this test procedure. The types not covered did not have a defined test procedure for wattage control or in the case of auxiliary lamp devices was not considered important enough to test.

5.2.2 System Operating Voltage Range

Voltage range is an important parameter for devices/systems which are regulated over a defined range. The controlling parameters of the light source are influenced by this voltage control, thus any deviations/ fluctuations measured before/after a test are critical to the overall performance of the device. It is for these reasons that the particular lamp types have been designated in 5.2.2 for this test procedure. The types not covered did not have a defined test procedure for voltage control or in the case of incandescent sources was not considered important enough to test outside it's defined nominal value.

5.3 Source Photometric Maintenance

Photometric maintenance of a Distributed Lighting System source should not deteriorate significantly over the life of the system. Maintenance measurement methods are dictated by the type of source employed and maintenance may vary depending on the source type. There are no requirements for some designs.

5.4.1 Color

The referenced specification applies to the overall effective color of light emitted by the device in any given direction and does not address requirements for the color(s) of light source(s) or the color filtering/ absorbing properties of distributed lighting components, such as plastic light guides.

5.4.2 Color Rendering Index

Since headlamp light sources emit light with spectral content significantly different than sunlight, a high Color Rendering Index (CRI) assures that the driver will see objects illuminated by the vehicle forward lighting system with acceptable color fidelity.

5.5 Leakage Current/breakdown Test

Although some materials have excellent dielectric properties, there are no perfect insulators. Therefore, electronic modules that contain high power components should be tested to ensure that there is no appreciable leakage or coupling of current to the exposed surfaces of the unit. The module should be checked in all power states while at anticipated temperature/humidity extremes.

5.6 Thermal Cycle

In general the Thermal Cycle Test is only specified for the Road Illumination Devices (forward lighting), and the Signal and Marking Devices (signal lighting) are subjected to the Warpage Test. In addition, if there are electronic control modules included in the signal lighting system, it should be subjected to the Thermal Cycle Tested specified for the modules. For more general purposes, the Thermal Cycle Test of all distributed lighting systems is listed now under each type (group) defined in the beginning of the document. Furthermore, based on uniqueness of discharge and LED light sources that could be used in the distributive lighting systems, the Thermal Cycle Tests for these types of systems are referred to the corresponding SAE documents.

5.7 Humidity/Moisture

Following the rationale developed for SAE J2357, this section considers the adverse affects that humidity and moisture can have on the optical, mechanical, and electrical performance of a DLS system. Different locations on the vehicle have different levels of exposure to hazards. Thereby, the testing is tailored to the expected hazard level associated with the various functional elements of the DLS system.

5.8 Internal Heat (Applicable only for Lighting Devices that contain a Distributive Lighting Source)

An internal heat test will not be required for the typical Distributed Lighting System where the light source is located in an external remote location outside the device. However, it will be required should the device contain the DLS light source or an additional/supplemental light source.

5.9 Sand, Dust, and Gravel Test:

This section considers the adverse affects sand, dust, and gravel contamination can have on the optical, mechanical, and electrical performance of a DLS system. Different locations on the vehicle have different levels of exposure to hazards. Thereby, the testing is tailored to the expected hazard level associated with the various functional elements of the DLS system.