

Specification for Testing Gas Discharge Light Source Subsystem

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SPECIFICATION FOR TESTING GAS DISCHARGE LIGHT SOURCE SUBSYSTEM

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1. SCOPE

This specification is a general level subsystem light source specification that establishes test requirements of a Gas Discharge Light Source (GDLS) subsystem for use on passenger vehicles.

The completed test data to this test specification is intended to be provided to the OEM by the Tier one lamp set maker as part of the lamp assembly PPAP. Re-testing shall be required if any portion of the approved GDLS experiences a design, manufacturing or component change.

This document shall be applied to systems that meet the requirements for design, performance and validation established by government standards.

The subsystem is defined as the ballast, igniter and light source and shall be tested as a subsystem and considered one test sample for the entire test sequence. A failure of any component in the test sample shall constitute a failure of the entire sample. Substitution or replacement of only the light source shall be allowed during testing. Failure of the light source more than once in a tested system shall constitute a failure of the GDLS. *If other manufacture's components are intended to be approved for use in the GDLS, then those possible combinations of components shall be considered a new GDLS and shall also be tested.*

Additional testing may be required by individual OEM's to meet specific EMC, quality, reliability and durability objectives.

The following tests are to be performed under the following conditions:

- New light source (capsule) or ballast design
- Design or process change made to an existing capsule or ballast, which could affect the outcome of the test
- Completion of one calendar year as noted in the "ANNUAL TESTS" Table shown in the Appendix. *(Note: Production process control data, collected at a shorter interval per an approved control plan, may be substituted if approved by customer's responsible engineer and purchasing representative.)*

2. SAFETY PRECAUTIONS

HID bulbs have pressurized gas inside, may contain mercury, and require special handling. They can burst or shatter if scratched or dropped.

HID ballasts utilize high voltages to strike the arc. Use caution when handling.

Wear appropriate eye protection, gloves, and shielding when performing any tests on bulbs covered by this specification.

Use caution when handling a bulb that has recently been energized. These bulbs operate at a very high temperature.

Protect operating lamps from contact with liquid and moisture. Liquid contacting a hot bulb can cause it to shatter.

Hold the bulb only by the base. Do not touch the glass portion of the bulb with bare hands.

This specification may involve hazardous materials, operations, and equipment. This specification does not purport to address all the safety concerns associated with its use. It is the responsibility of whoever uses this specification to consult and establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2.1 HIGH VOLTAGE IDENTIFICATION/LABELING

The GDLS shall meet the requirements of SAE J1673 - High Voltage Wiring Assembly Design. If a high voltage label is used, it shall meet the requirements of ISO 2575 Symbol M06 shown here.



ISO 2575 Symbol M06

3. REFERENCE STANDARDS

In the event of a conflict between the text of this specification and the documents cited herein, the text of this specification takes precedence. Nothing in this specification, however, supersedes applicable laws and regulations unless a specific exemption has been obtained. The latest issue of reference documents shall apply.

- (FMVSS) Federal Motor Vehicle Safety Standard No. 108
- (CMVSS) Canada Motor Vehicle Safety Standard No. 108
- Part 564 of Federal Motor Vehicle Safety Standard No. 108
- CIE Publication 13.3 Dated 1995
- ECE-Regulation 98, Uniform Provisions Concerning The Approval Of Motor Vehicle Headlamps Equipped With Gas-Discharge Light Sources
- ECE-Regulation 99, Uniform Provisions Concerning The Approval Of Gas-Discharge Light Sources For Use In Approved Gas-Discharge Lamp Units Of Power-Driven Vehicles

- AIAG/APQP-2: Chrysler, Ford, and General Motors Advanced Product Quality Planning and Control Plan Reference Manual
- AIAG/MSA-3: Measurement Systems Analysis Reference Manual
- AIAG/FMEA-3: Potential Failure Mode and Effects Analysis Reference Manual (SAE J1739)
- AIAG/PPAP-3: Chrysler, Ford, and General Motors Production Part Approval Process Manual
- ASTM B117 (Standard Practice for Operating Salt Spray [Fog] Testing Apparatus)
- Chrysler, Ford, and General Motors Quality System Requirements-QS-9000 Manual
- AIAG Fundamental Statistical Process Control Reference Manual

- IEC 60068-2-1, Cold
- IEC 60068-2-2 Ba, Dry Heat
- IEC 60068-2-14 Na, Rapid Change of Temperature With Prescribed Time of Transition
- IEC 60068-2-14 Nb, Change of Temperature with Specified Rate of Change
- IEC 60068-2-27 Ea, Mechanical Shock
- IEC 60068-2-32 Ed, Free Fall
- IEC 60068-2-64, Vibration
- ISO TC 22/SC 3/WG 13 N139 Road vehicles-Environmental conditions and testing for electrical and electronic equipment – Part 1: General
- ISO TC 22/SC 3/WG 13 N140 Road vehicles-Environmental conditions and testing for electrical and electronic equipment – Part 2: Electrical loads
- ISO TC 22/SC 3/WG 13 N142 Road vehicles-Environmental conditions and testing for electrical and electronic equipment – Part 3: Mechanical loads
- ISO TC 22/SC 3/WG 13 N141 Road vehicles-Environmental conditions and testing for electrical and electronic equipment – Part 4: Climatic loads
- ISO 2575 Index M – Electrical Functions in General and Electric Road Vehicles
- SAE/USCAR – 2, Performance Standard for Automotive Electrical Connector Systems.
- SAE/USCAR – 12 Wiring Component Design Guidelines
- SAE/USCAR – 20 Field Correlated Life Test Supplement To SAE/USCAR-2
- SAE/USCAR – 21 Performance Specification for Cable-To-Terminal Electrical Crimps
- 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 J1330 Photometry Laboratory Accuracy Guidelines
- SAE J1344 – Marking of Plastic Parts

- SAE J1383 - Performance Requirements for Motor Vehicle Headlamps
- SAE J1673 – High Voltage Wiring Assembly Design
- SAE J2009 Discharge Forward Lighting System and Subsystems
- SAE J2357 Application Guidelines for Electronically Driven and/or Controlled Exterior Automotive Lighting Equipment
- VDA 260 Marking Standard – Federation of the Automobile Industry
- Q7-K: Chrysler, Ford Motor Company and General Motors QS-9000 Supplier Quality Requirements

**Copies of the AIAG Manuals can be obtained from AIAG (Automotive Industry Action Group) by calling (248) 358-3570 or by writing to AIAG, Dept. 77839, Post Office Box 77000, Detroit MI 48277-0839, Attn: Customer Service.

4. DIAGRAMS AND DEFINITIONS

4.1 APPENDICES

Diagrams are provided at the end of this specification to clarify the details of the test procedures. A Glossary of Terms is also included in the Appendix.

5. GENERAL REQUIREMENTS

5.1 RECORD RETENTION

Supplier must maintain a file for the storage of laboratory reports and calibration records, and establish a record retention policy concerning these records in accordance with QS-9000 and PPAP requirements. These records need not follow a standard format, but must present the required data in an orderly, professional manner. The file must be made available to any and all customer personnel upon request, including—but not limited to—representatives from the following areas: product engineering, purchasing, quality, and reliability.

5.1.1 Objectives of Record Retention

Following are the main objectives for retention of test documents or records:

1. Retain records that will evidence compliance so that the supplier can appropriately respond when or if product compliance is challenged. Files must exist for the storage of all laboratory records, data, and calibration records. The files must be available at any time for audit or inspection.

2. Retain records as needed to assist in evidencing the exercise of "due care" in matters relating to product compliance, government requirements, or product liability.
3. Comply with statutory requirements for the maintenance and retention of specific records.

5.1.2 Retention Methods

Methods of retention may include retention of original documents, the use of film, or the use of electronic storage equipment. Records shall be stored so that they are accessible in a reasonable amount of time. Storage areas should provide adequate protection from unauthorized access, moisture, and fire.

5.2 SAMPLE DOCUMENTATION AND RETENTION

Engineering test samples must be identified by Industry Accepted Trade Number and manufacturer's serial number unless otherwise noted. Documentation must identify the type of test performed and describe special tests that are not a part of this specification. (Reference QS-9000 and PPAP requirements.)

5.2.1 Required Data Package

Supplier must submit the data package for the appropriate level of submission to the customer's responsible engineer and purchasing division for approval signatures.

5.2.1.1 PRODUCTION PROCESS APPROVAL

The GDLS design shall be capable of meeting the requirements of Automotive Industry Action Group (AIAG) document "Production Part Approval Process" (PPAP) and GM document GM-13901 PPAP General Motors Operating Policy.

5.2.2 Sample Retention

Samples tested to attain part approval must be retained by the bulb manufacturer for a period of time specified in the PPAP Manual.

5.3 POWER SOURCES

Supplier must use voltage regulated DC power sources for all tests to simulate an automotive battery and charging system.

5.3.1 Output Current

The power source must be capable of supplying a continuous output current as required by the design loads, including inrush current. Where required to simulate automotive inrush current conditions, an automotive battery or batteries with sufficient cold cranking amps may be connected in parallel with the power supply.

5.3.2 Output Voltage

The power source must be capable of supplying an output voltage that must not deviate more than 1.0 volt from the nominal setting over the entire load range (including surges). The power source must recover 63% of its maximum excursion within 5.0 milliseconds. Ripple voltage must not exceed 500 mV peak to peak. Power supplies used for photometric measurements must conform to SAE J1330.

5.4 EQUIPMENT TOLERANCES

Supplier must use test setups and equipment capable of measuring test parameters (expressed in nominals) within the limits found in Equipment Tolerance Table.

Equipment Tolerance Table

Test Chamber Temperature/Humidity	nominal $\pm 3^{\circ}\text{C}$ Relative Humidity $\pm 5\%$
Time	nominal $\pm 0.5\%$
Forces	nominal $\pm 0.1\text{ N}$
Distances	nominal $\pm 0.1\text{ mm}$
Voltages	nominal $\pm 0.01\text{ V}$ for photometrics
	nominal $\pm 0.1\text{ V}$ for all other tests
MSCD	nominal $\pm 2.0\%$

NOTE: This table is not to be used for performance dependent variable (Refer to section Measurement Accuracy).

5.5 MEASUREMENT ACCURACY

Meters and gauges used to assess the performance dependent variable, as defined by the basic function of the test sample, must have a smallest unit of measure one order of magnitude less than the least significant digit specified. For example, even though a 0.6 mm and 0.60 mm wire might be the same diameter, calipers capable of 0.01 mm resolution may be used to measure the first wire, but a micrometer with 0.001 mm resolution is needed for the second wire.

5.6 TEST REPEATABILITY AND CALIBRATION

5.6.1 Equipment Repeatability

All measurement equipment used for product evaluation must be repeatable to within 10% of the part tolerance according to Chrysler, Ford, and General Motors Measurement Systems Analysis Reference Manual.

5.6.2 Equipment Calibration

Equipment re-calibration/re-certification timing is to be calculated based on the capability of any individual instrument to retain its "Manufacture Stated Accuracy" between recall periods. However, this time shall not exceed one year.

5.6.3 Laboratory Masters (Photometry Only)

Lamps which are traceable to known standards are laboratory masters. Each supplier must use laboratory masters for comparison measurements, calibration of test equipment, and for evaluating long-term drift in test equipment.

5.7 TEST DEFAULT CONDITIONS

Tests shall be accomplished under conditions and methods specified herein. When specific test conditions are not given, the following basic conditions apply: Reference ECE R99 Annex4

1. Test the bulb in the operating orientation as specified in ECE R99 Annex 4, sub-paragraph, "BURNING POSITION".
2. Voltage input to ballast..... 13.5 Vdc
3. Perform tests or measurements at the following ambient temperature.....25°C +/- 5°C
4. The GDLS shall be seasoned / aged (except as noted in individual tests) in accordance with ECE Regulation 99 Annex 4.

When a test implementation or method is not specified in detail, the exact method and test equipment implementation shall be developed by the Supplier.

It is the intention of this specification that the gas discharge light source, used as part of the GDLS, shall meet the Technical Requirements as stated in Section 3 of ECE Regulation 99 "Uniform Provisions Concerning the Approval of Gas-Discharge Light Sources for use in Approved Gas-Discharge Lamp Units of Power-Driven Vehicles".

5.8 TEST SHARING WITHIN LIGHT SOURCE FAMILIES

The results of tests performed on one light source type may, in some cases, be used to indicate the capability of another light source type within the same family. For example, a crush test performed

on a D1-S, type may be used as a demonstration of the glass strength of D1-R, D2-S and D2-R types made by the same process from the same glass from the same source. Sound judgment must guide this practice. Light sources within the same family that share components such as glass envelopes, lead wires, electrodes, bases, fill gases, etc., may be able to share test results. The customer will be the final authority on whether this surrogate data may be used.

5.9 TEST FAILURE PROCEDURE

Should a test failure occur, the customer (Quality, Purchasing, and Design/Release Engineer) shall be notified immediately. When contact cannot be immediately made, stop the test until the requesting party can be contacted.

5.10 CONTROL PLANS

Supplier must maintain a control plan, consistent with the AIAG, for each light source, ballast and ignitor type that contains appropriate controls to ensure that all the significant/critical characteristics covered by the tests in this document are met.

5.11 RELIABILITY PROGRAMS AND METHODS

5.11.1 Reliability Growth and Ongoing Quality Improvements

Suppliers must establish and implement a plan to improve demonstrated product quality and reliability. They must establish procedures for analyzing and correcting end-of-line defects and predominant failure modes identified by the field return program. True reliability growth occurs when design changes to the GDLS or manufacturing process are made to eliminate the failure modes.

5.11.2 Notification of Process Changes

Suppliers must notify the customer of manufacturing process, material, or design changes to determine if resubmission for PPAP approval is required.

5.11.3 Quality/Reliability Improvement Tools

Suppliers must use appropriate methods to improve the quality and reliability of their products in accordance with QS-9000. Examples of such methods are Field Return Programs, Design Failure Mode Effects Analysis (DFMEA), Process Failure Mode Effects Analysis (PFMEA), and Fault Tree Analysis (FTA) or Fishbone Diagrams. Further information on these methods is available from the Automotive Industry Action Group (AIAG).

5.12 HAZARDOUS MATERIAL RESTRICTION

Any regulated substance that is identified by any federal, state, provincial, or local government unit or automotive manufacturer, shall not be used in the manufacturing process of any GDLS components. Any GDLS components manufacturer that is currently supplying hazardous material in a component will submit a timeline to General Motors, Ford, and Chrysler for the removal of said product.

Materials selected for use in the GDLS shall not produce corrosive or deleterious fumes under manufacturing, assembly, operating or test conditions stated herein. Materials used within the Discharge Light Source shall meet the intent of this requirement consistent with specific need to obtain required light output characteristics.

5.12.1 RECYCLABILITY

The GDLS is considered a recyclable item and the design shall utilize recyclable materials where practical.

5.12.1.1 RECYCLING INFORMATION

The GDLS shall be marked with recycling information with either specific instructions or molded marking in accordance with SAE J1344 or VDA 260, as appropriate.

The light source shall be marked to indicate the presence of mercury, if appropriate.

5.12.2 ITEM DIAGRAM

A block diagram for the GDLS and interfacing elements is shown in Figure 3.1.1-1. Internal partitioning, content, design and construction details to meet requirements of this specification are at the discretion of subsystem supplier except as otherwise specified herein.

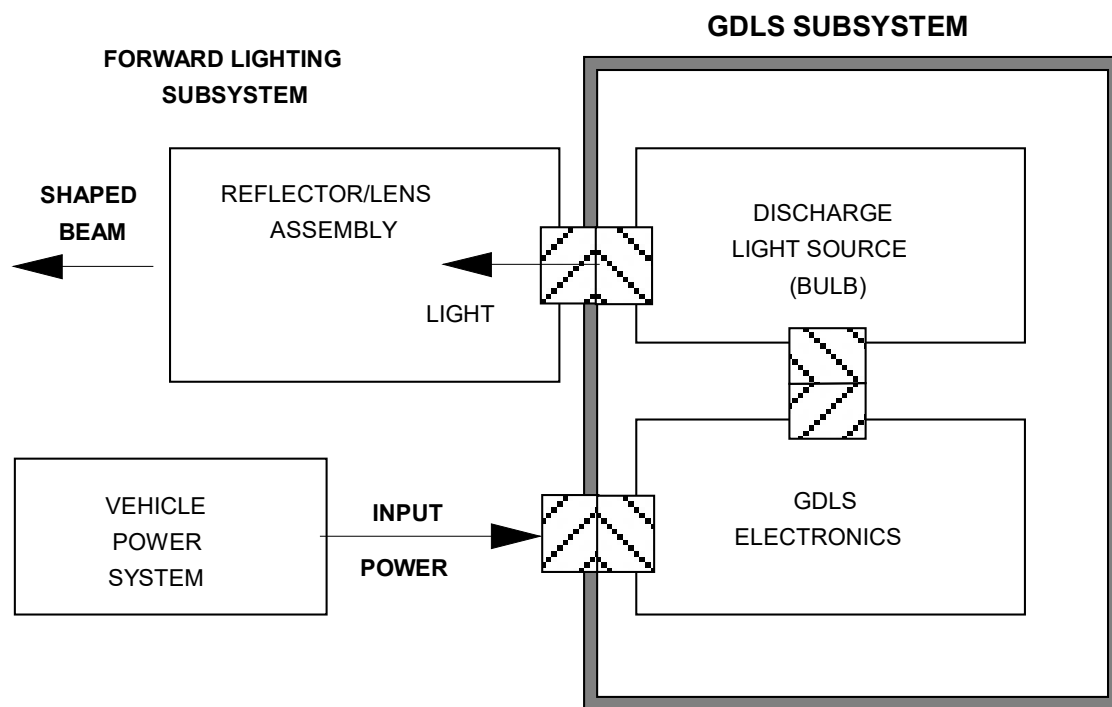


FIGURE 3.1.1-1

6. ENVIRONMENTAL

Tests shall be conducted on GDLS representative of production assemblies. Unless otherwise specified in any individual test, for purposes of environmental testing, nominal voltage V_{nom} shall be design voltage, low voltage V_{low} shall be 9.0 volts and high voltage V_{high} shall be 16.0 volts. The operating voltage shall be nominal for 80%, low for 10% and high for 10% of the functional tests and/or cycles.

The GDLS shall be designed to meet all performance requirements while exposed to steady state or oscillating ambient temperatures ranging from $\geq -40\text{ }^{\circ}\text{C}$ to $\leq 105\text{ }^{\circ}\text{C}$. Maximum temperature excludes local temperature rise from heat generated by Discharge Light Source during operation when installed into headlamp housing.

6.1 TEMPERATURE SOAK

Temperature soak simulates the GDLS exposed to hot and cold temperatures for prolonged periods of time during storage or use.

Reference IEC 60068-2-2, Dry Heat Test Ba (T_{max} is $105\text{ }^{\circ}\text{C}$) for a minimum duration of 96 hours and IEC 60068-2-1, Cold Test Aa (T_{min} is $-40\text{ }^{\circ}\text{C}$) for a minimum duration of 24 hours.

6.1.1 Test and Measurement Apparatus

1. Environmental Chamber (circulating air type) Capable of $T_{Min} = -40\text{ }^{\circ}\text{C}$ and $T_{Max} = 105\text{ }^{\circ}\text{C}$
 - The environmental chambers shall be capable of maintaining the atmosphere at the appropriate temperature for the test in any region where the specimen is placed.
 - The absolute humidity in the chambers shall not exceed 20 g/m^3
 - The air in the chambers shall be circulated. Air velocity measured close to the test specimen shall be not less than 2 m/s .
2. Power Source
3. GDLS Mounting Fixture
 - The GDLS shall be tested using mounting or supports with low thermal conduction, such that for practical purposes the specimen is thermally isolated. When testing several specimens simultaneously they shall be so placed that free circulation should be provided between specimens and between chamber surfaces.
 - The Discharge Light Source may be mounted in a lamp housing or otherwise protected during this testing; however, all interfaces, connectors and wiring must be exposed.

6.1.2 Procedure

- 1) Mount the GDLS on the fixture using the devices attachment points. No component of the GDLS shall come into contact with the chamber surfaces.
- 2) Power the GDLS for 1 minute at 13.5 Vdc.
- 3) Remove power from GDLS during temperature soak.
- 4) Set chamber settings to $T_{\max}$ and a maximum 50% relativity humidity and allow to stabilize.
- 5) Soak at $T_{\max}$ for 96 hours.
- 6) At the end of the 96 hour soak, power the GDLS for 1 minute at 16.0 Vdc.
- 7) Remove power from GDLS.
- 8) Allow to cool to room temperature.
- 9) Lower the chamber temperature to $T_{\min}$ and allow to stabilize.
- 10) Soak at $T_{\min}$ for 24 hours.
- 11) At the end of the 24 hour soak, power the GDLS for 1 minute at 9.0 Vdc.
- 12) Remove power from GDLS.
- 13) Allow the chamber to reach room temperature.
- 14) Power the GDLS for 1 minute at 13.5 Vdc.

6.1.3 Acceptance Criteria

- 1) The GDLS shall not show any evidence of visible fractures, warpage or deformation.
- 2) The light source shall illuminate continuously each time it is powered.

6.2 THERMAL SHOCK IN AIR (TS).

6.2.1 Purpose

The GDLS shall be designed to withstand thermal stresses due to power cycling and rapid changes in ambient temperature without degradation in performance.

The Discharge Light Source may be mounted in a lamp housing or otherwise protected during this testing; however, all interfaces, connectors and wiring must be exposed.

This is an accelerated test to evaluate failure mechanisms, which may be driven by mismatches in coefficients of thermal expansion.

6.2.2 Test and Measurement Apparatus

1. Environmental Chamber (circulating air type) #1 @ $T_{\min} = -40\text{ }^{\circ}\text{C}$
2. Environmental Chamber (circulating air type) #2 @ $T_{\max} = 105\text{ }^{\circ}\text{C}$

- The environmental chambers shall be capable of maintaining the atmosphere at the appropriate temperature for the test in any region where the specimen is placed.
 - The absolute humidity in the chambers shall not exceed 20 g/m³
 - The volume of the chambers and the air velocity shall be such that after insertion of the test specimens, the temperature within the chambers shall be within the specified tolerance after a time of not more than 10% of the exposure time.
 - The air in the chambers shall be circulated. Air velocity measured close to the test specimen shall be not less than 2 m/s.
3. Power Source
4. GDLS Mounting Fixture
- The GDLS shall be tested using mounting or supports with low thermal conduction, such that for practical purposes the specimen is thermally isolated. When testing several specimens simultaneously they shall be so placed that free circulation should be provided between specimens and between chamber surfaces.
 - The Discharge Light Source may be mounted in a lamp housing or otherwise protected during this testing; however, all interfaces, connectors and wiring must be exposed.

6.2.3 Procedure.

Reference IEC 60068-2-14 Na. Upon agreement, this test can be performed during the development process without a case (or with a modified case).

1. Test Chamber #1 and #2 shall be stabilized to T_{Min} and T_{Max} respectively, prior to inserting test specimens.
2. The GDLS shall soak at T_{Min} for 10 minutes and then transferred to test chamber #2.
3. Transfer time between chambers shall not exceed 30 seconds.
4. The GDLS shall soak at T_{Max} for 20 minutes.
5. Repeat steps 2 through 4 for a minimum number of 300 cycles. (refer to Table Combined Thermal Shock / Power Temperature Cycling)
6. Lamp and ballast shall be energized once daily for 10 minutes at 105 °C and once daily at -40 °C for the last 2 minutes of the 10 minute soak.
7. Test shall be stopped if light source fails to illuminate when energized.

6.2.4 Acceptance Criteria.

The light source shall illuminate each time it is operated and at the completion of the test.