

Recommended Qualification Tests for Halogen Miniature Lamps Less  
Than 35 Watts for Aircraft Applications

RATIONALE

This document has been composed to provide guidance for qualification testing of halogen lamps.

1. SCOPE

This SAE Aerospace Recommended Practice (ARP) provides the qualification test procedure requirements for low wattage halogen lamps (less than 35 Watts) intended for use primarily in aircraft applications. The purpose of these tests is to provide a laboratory means of determining the performance characteristics of lamps in airplane power and environmental conditions and to verify the integrity of the lamp design and production process.

2. REFERENCES

EN 2756 Lamps, Incandescent Test

RTCA/D0-160 Environmental Conditions and Test Procedure for Airborne Equipment

3. GENERAL REQUIREMENTS

3.1 Test Conditions

Unless otherwise specified, tests shall be conducted under the following ambient conditions:

- a. Temperature: 10 to 30 °C (50 to 86 °F)  $\pm 2$  °C ( $\pm 3.6$  °F)
- b. Humidity: 20 to 80%  $\pm 5\%$  Relative
- c. Pressure: 25 to 31 inches of Mercury (846.5 to 1049.8 millibars)

Where tests are specified at other than ambient conditions, the following tolerances apply:

- a. Temperature:  $\pm 2$  °C ( $\pm 3.6$  °F)
- b. Humidity:  $\pm 5\%$  Relative
- c. Altitude:  $\pm 5\%$

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### 3.2 Test Samples and Group Samples

Test samples must represent production lamps and must be subject to production screening. In order to reduce time in a qualification program, lamps shall be divided into five groups of 10 lamps each, and they shall be tested per the sequence shown in Table 4.

### 3.3 Production Screening Test

The purpose of this test is to eliminate lamp infant mortality. Every production lamp shall be subject to an operational screening at rated voltage for 0.2% of rated life or 5 hours whichever is lower.

### 3.4 Control Test

Purpose: The purpose of this test is to verify the lamp performance before and after each qualification test.

Procedure: This test shall include an article examination and photometric and lamp current measurements at rated voltage. Lamps shall be physically inspected for dimension and workmanship for conformance with the appropriate lamp specification.

Pass/Fail Criteria: After 5 minutes of operation or thermal stabilization, if the light output is less than or greater than 20% of the rated mean spherical candle (MSC), or the lamp current is less than or greater than 5% of the rated current at rated voltage, then the lamps fail the control test.

## 4. QUALIFICATION TEST REQUIREMENT

### 4.1 Photometric Test

Purpose: The purpose of this test is to measure the light output and lamp current at rated voltage, 5% below rated voltage and 5% over rated voltage.

Procedure: The lamp is placed in a calibrated integrating sphere photometer. For calibration of the photometric equipment, the standard lamps traceable to master standard lamps which are traceable to the National Institute of Standards and Technology shall be used. The lamp is powered by an AC or DC power supply at a rated voltage level. After reaching the thermal stabilization, the MSC and the input current shall be recorded. Repeat the MSC measurement for 5% over rated voltage and 5% below rated voltage. Verify that the measured data as expected values.

Pass/Fail Criteria: The power (IxV) shall be equal to  $\pm 5\%$  the specified values, and the MSC shall be in  $\pm 20\%$  of the appropriate lamp specification.

### 4.2 Electrical Tests

#### 4.2.1 Insulation Resistance

Purpose: The purpose of the insulation resistance test is to verify the integrity of the isolation between two lead wires or between the contact and the outer base.

Procedure: Mechanically break the filament and then measure the isolation resistance between the mutually insulated terminals, e.g., between lead wires or between the contact and the outer base. The insulation resistance shall be measured at 500 VDC.

Pass/Fail Criteria: The insulation resistance shall not be less than 100 M $\Omega$ .

#### 4.2.2 Dielectric Strength

Purpose: The purpose of this test is to verify the integrity of the isolation between the lead wires or between the contact and the outer base.

Procedure: A dielectric withstanding voltage of 1500 V rms, 60 Hz, shall be applied between the isolated lead wires or between the contact and the outer base for 1 minute. The voltage shall be applied and removed at a uniform rate of 250 to 500 volts per second.

Pass/Fail Criteria: Any arcing as evidenced by flash over, spark over, breakdown or leakage current exceeding 2 milliamperes shall constitute failure. After this test the above insulation resistance test shall be repeated.

#### 4.2.3 Power Input and Voltage Spike

Purpose: The purpose of these tests is to verify that the lamp operates satisfactorily for aircraft power conditions.

Procedure: The lamp shall be tested to meet the requirements for both AC and DC voltage sources as shown in Section 16, Power Input, and Section 17, Voltage Spike, of the RTCA/DO-160. In case where a transformer must be used to step-down the voltage for a low voltage lamp, e.g., 115 VAC/28 VAC, then all abnormal input voltage, surge voltage and others except the voltage spike shall be calculated accordingly with the same ratio.

Pass/Fail Criteria: The test article shall operate satisfactorily without burnout or degradation of performance.

### 4.3 Environmental Tests

#### 4.3.1 Thermal and Altitude

Purpose: The purpose of these tests is to verify the performance of lamps in the non-temperature controlled and non-pressurized areas.

Procedure: The lamps shall be tested per Section 4 of the RTCA/DO-160, Category D2.

Pass/Fail Criteria: The lamps shall operate satisfactorily without performance degradation.

#### 4.3.2 Thermal Variation

Purpose: The purpose of this test is to verify satisfactory performance of the lamps during normal temperature variations between high and low operating temperature extremes specified for category B as defined in Section 5.2 of RTCA/DO-160.

Procedure: Lamps shall be tested per Section 5, Temperature Variation, of RTCA/DO-160.

Pass/Fail Criteria: Any degradation of lamp performance shall constitute failure.

#### 4.3.3 Salt Spray

Purpose: The purpose of this test is to determine the effects on the lamp of prolonged exposure to a salt atmosphere or to salt spray experienced in normal operation.

Procedure: Lamps shall be tested per Section 14, Salt Spray, of the RTCA/DO-160, Category S.

Pass/Fail Criteria: Any evidence of corrosion of base, insulation fault or damage to contacts shall constitute failure.

#### 4.4 Mechanical Tests

It is recommended that the lamp is qualified to meet the mechanical test per EN 2767. However, it should be considered for lamp housing application; therefore, the vibration standard of RTCA/DO-160 is recommended.

##### 4.4.1 Vibration

**Purpose:** The purpose of this test is to verify that the performance of the lamp design complies with the standard vibration for equipment mounted on an instrument panel, console, equipment rack, or light fixture in fixed wing aircraft with turbojet engines.

**Procedure:** Lamps shall be subjected to the Standard Vibration as defined in Section 8 of the RTCA/DO-160 after aging for 25% of their rated life. The vibration spectrum shall be from 5 to 2000 Hz, and the acceleration power spectral density level as those required for equipment mounted on instrument panel, console, equipment rack or light fixture. Throughout the entire vibration test the power (at rated voltage) to the lamps must be switched with a cycle of 10 minutes on and 10 minutes off.

**Pass/Fail Criteria:** Lamps shall still be functioning and show no evidence of damage to any lamp component or loose parts due to the vibration testing.

##### 4.4.2 Tensile Test

**Purpose:** The purpose of this test is to verify the integrity of the lamp base strength to handle the insert force during lamp installation.

**Procedure:** For bi-pin lamps, an insert force as specified in Table 1 shall be applied progressively between the bulb and one of the pins along the axis of the pin for 1 minute.

For bayonet base lamps, an insert force as specified below shall be applied progressively between a surface simulating a terminal of the lamp socket and the center contact of the base along the axis of the base for 1 minute.

**Pass/Fail Criteria:** After the test, lamps shall function normally, and there shall be no sign of lamp component damage or deformation.

TABLE 1 - INSERT FORCE

Type of Base	Bi-pin	Bayonet	Others
Insert Force	10N*	15N*	*
* This is the recommended force. It is recommended that the lamp manufacturers and light assembly manufacturers provide the required values for actual application.			

##### 4.4.3 Torque Test

**Purpose:** The purpose of this test is to verify the integrity of the lamp base strength to handle the torque during lamp installation.

**Procedure:** A torque, as defined in Table 2, of which the axis coincides with that of the base, is applied progressively between the bulb and the base. This force is maintained for 1 minute.

**Pass/Fail Criteria:** After the test, lamps shall function normally, and there shall be no sign of lamp component damage or deformation.

TABLE 2 - INSERT TORQUE

Type of Base	Bayonet	Others
Insert Torque	0.5Nm*	*
* This is the recommended torque. It is recommended that the lamp manufacturers and light assembly manufacturers provide the required values for actual application.		

#### 4.5 Life Test

##### 4.5.1 Static Life Test

Static life of the lamps is identified as the time from the static life test defined in this section beginning to the time 50% of the lamps fail the test.

Purpose: The purpose of this test is to determine the lamp performance in controlled laboratory conditions without power interruption except at several specified periods for light output verification.

Procedure: Lamps shall be subjected to power at the constant rated voltage and the current shall be monitored for indication of light loss. The light output (MSC) shall be monitored. If the average of the light output of each lamp lost more than 20% of the initial light output, then remove that lamp from the test. If the lamp is intended for using for both DC and AC voltage applications, then two groups of lamps are required for this test.

Pass/Fail Criteria: A lamp burning out or losing more than 20% of the initial light output at rated voltage shall constitute failure.

##### 4.5.2 Accelerated Static Life Test

Purpose: The purpose of this test is to reduce the qualification time for lamp rated life more than 4000 hours by running the static life test at 10% over rated voltage and use the relationship of life and operation voltage to calculate the static lamp life.

Procedure: The accelerated static life test is conducted as static life test except lamps shall be powered at 10% over rated voltage. The following formula is the relationship between life and operating voltage.

$$\text{Accelerated Lamp Life} = \text{Rated Lamp Life} \cdot \left( \frac{\text{Rated Voltage}}{\text{Operating Voltage}} \right)^{12} \quad (\text{Eq. 1})$$

Pass/Fail Criteria: A lamp burning out or losing more than 20% of the initial light output at rated voltage shall constitute failure.

##### 4.5.3 Dynamic Life Test

Purpose: The purpose of this test is to determine the performance of the lamps in different operating conditions such as temperature, power cycling, over voltage and vibration.

Procedure: These tests shall consist of the five phases defined in Table 3.

Pass/Fail Criteria: Lamps shall function normally and show no sign of lamp component damage or deformation after all phases.