

U.S. DEPARTMENT OF TRANSPORTATION  
FEDERAL AVIATION ADMINISTRATION

**FAA LOGISTICS CENTER SPECIFICATION**

**PAR-38 MALS Lamp**  
**Airfield Duty**



This Specification contains 26 pages

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## 1.0 SCOPE

### 1.1 Scope

This specification defines the minimum requirements for PAR-38 lamps used in a variety of Medium intensity Approach Lighting Systems (MALS) systems. MALS systems provide the pilot of the aircraft visual confirmation, when the craft is on the correct path for landing. These systems operate at maximum power in the most severe outdoor environmental conditions.

### 1.2 Classification

This specification defines the following lamp.

MALS lamp for airfield use:

PAR 38, medium skirted base, narrow spot, 120 volts, outdoor, vibration duty.

## 2.0 APPLICABLE DOCUMENTS

### 2.1 FAA Documents

The following FAA documents form a part of this specification.

#### 2.1.1 FAA Drawings

DE-C-3390A Lamp Life Definition

### 2.2 Military Documents

The following military and federal documents form a part of this specification and are applicable to the extent specified herein.

#### 2.2.1 Military Standards and Specifications

MIL-STD-129L Marking for Shipment and Storage

MIL-STD-810F Test Method Standard for Environmental Engineering Considerations and Laboratory Tests

### 2.3 Other Standard Documents

The following national standards form a part of this specification and are applicable to the extent specified herein.

ANSI/ASQC Z1.4	Sampling Procedure for Inspection by Attributes
ASTM D 3580	Standard Test Method of Vibration (Vertical Sinusoidal Motion) Test of Products
ASTM D 3951	Standard Practice for Commercial Packaging
ASTM D 4169	Standard Practice for Testing of Shipping Containers and Systems
ASTM D 5112	Standard Test Method for Vibration (Horizontal Linear Sinusoidal Motion) Test of Products

#### 2.4 Document Availability

Copies of this specification, other applicable FAA specifications and FAA drawings may be obtained from the Contracting Officer in the office issuing the Screening Information Request (SIR).

Copies of MIL-STD-129L and MIL-STD-810 can be obtained from:

DODSSP  
Customer Service  
Standardization Documents Order Desk  
700 Robbins Avenue, building 4D  
Philadelphia, PA 19111-5094

Also available from the ASSIST option of the DODSSP website at

<http://www.dodssp.daps.mil/dodssp.htm>

Copies of ASTM documents can be obtained from:

ASTM  
100 Barr Harbor Dr.  
West Conshohocken, PA 19428  
Telephone (610)-832-9500

#### 2.5 Precedence

In case of conflict between this specification and the specifications and standards referenced in 2.1, 2.2 and 2.3, this specification shall govern. The contractor shall notify the Contracting Officer in writing, of any conflicts discovered and not resolved by this order of precedence.

### 3.0 REQUIREMENTS

#### 3.1 General

The lamps of this specification are used for outdoor operation. All lamps shall be sealed in a PAR-38 envelope, consisting of internally coated reflector and a lens or cover glass.

MALS lamps, mounted in a variety of FAA holders, are installed on the approach to airport runways, a minimum of two hundred feet from the landing threshold, extending away from the landing threshold. The lamps shall function in continuous or intermittent outdoor service under the environmental conditions specified herein.

Coated lamps, lamps with a film on the lens, are not acceptable unless the following criteria is met: The offerer must submit definitive test results proving the coating will not separate from the lens nor become opaque, i.e. lose more than five percent (5%) transmittance of visible light, after two (2) years of operation with exposure to sunlight as part of the bid or proposal. This actinic immunity shall be proven using Procedure II, Method 505.4 of MIL-STD-810F, and irradiance intensity of 1120 watts per square meter.

All further references to lamps in 3.2 through 6.2 hereafter, refer to both coated lamps and uncoated lamps.

#### 3.2 Requirements for all specified lamps

##### 3.2.1 Fungus Proof Materials

Whenever practicable, materials that are nutrients for fungi shall not be used. When such materials must be used and are not hermetically sealed, they shall be treated with a fungicide agent. The fungicide shall be approved as safe for human contact if applied to the exterior of the lamp.

##### 3.2.2 Metals

Metals shall be inherently corrosion resistant.

##### 3.2.3 Medium Skirted Base

MALS lamps shall conform to the standard physical dimensions for standard medium skirted base PAR-38 lamps.

#### 3.2.4 Marking

All lamps shall be permanently marked on the back of the reflector body with the day, month and year of manufacture and the manufacturer's name, logo or trademark or CAGE code. The marking shall be permanent and remain legible up to the minus three sigma ( $-3\sigma$ ) hours of rated life of the specific lamp design submitted for qualification.

The manufacturer's name, logo or trademark molded into the lens or body of the lamp may be substituted for that portion only of the requirements of the preceding paragraph.

#### 3.2.5 Workmanship

All lamps shall be free from blemishes and defects. Marking shall be clear, legible, and durable. Soldering, welding, brazing, cementing, and wiring shall be thorough. Alignment of parts shall be accurate. The base threads shall be uniform without burrs. The sealed lamp shall be free of loose internal items and debris.

#### 3.2.6 Cleaning

All lamps shall be thoroughly cleaned, and all loose, spattered, or excess solder, metal chips, flux, and other foreign material shall be removed during and after final assembly.

#### 3.2.7 Packing, Packaging and Marking

All lamps shall be packed, packaged and marked for storage and reshipment in accordance with Section 5.

### 3.3 Reserved

### 3.4 Lamp Performance Requirements

#### 3.4.1 Wattage Rating

The nominal wattage rating is the maximum voltage wattage rating for the specific lamp. All references to rated power are referring to the maximum voltage rating of the lamp. Wattage shall be measured over a one minute time period and is the average power measured in this one minute. The measurement shall be taken after the lamp has been conditioned or burned in for a period of time equal to one percent (1%) of the rated life of the submitted lamp design. No individual lamp shall have less than ninety five percent or exceed one hundred five percent (95% to 105%) of the average measured wattage rating of the design qualification sample.

The following formula will be used to adjust the offered price for all qualified lamp designs: Wattage, average value for the offered design sample as established by the qualification testing, times the hours of operation yielding the least cost of ownership by the FAA for the design, times \$0.048 per kilowatt hour. All offered prices will be adjusted using the nominal wattage of the ordering designation as the baseline.

Lesser energy efficient designs shall have their offered price adjusted upward to include the additional cost of operating power. More energy efficient designs will have their offered price adjusted downward. Refer to section 3.4.5, Life.

#### 3.4.2 Candela

The minimum acceptable candela values and the distribution of candela in the beam is specified in Table I. All luminous quantities specified or required by this specification are the sum of the visible radiant energy from a wavelength of three hundred-eighty nanometers (380nm) to seven hundred-seventy nanometers (770nm) inclusive.

All offers shall include as part of the offer of the beam and field candela distributions in isocandela diagram format, and the total lumen output of the offered lamp design.

#### 3.4.3 Overload

Lamps shall be capable of operating at one hundred ten percent (110%) of full rated voltage with no failure.

#### 3.4.4 Operating Power Range

All lamps specified by this specification are operated over a range of alternating current (AC) input voltage to adjust their intensity to atmospheric conditions at the time. All references to current rating or input in this document are to root mean square (rms) AC voltage. Halogen cycle lamps shall operate as a halogen cycle lamp over the entire range of input power specified.

The range of operating voltage is: Full rated power, 120 volts rms. Reduced power steps of 75 volts and 50 volts.

##### 3.4.4.1 Candela Output over Operating Power Range

The candela output of all halogen cycle lamps shall be within three percent ( $\pm 3\%$ ) of the lumen output predicted by the following equation over the entire input power range specified. The beam candela of the lamp shall be used to determine compliance.

5.56  
 $\text{candela} = \frac{[\text{volts}]^5}{1000}$  lower case are less than rated values  
**Candela [Volts] Bold CAPITALS are RATED VALUES.**

Incandescent lamps shall also have candela output that is within three percent ( $\pm 3\%$ ) of the output predicted by the equation with an equation exponent of 3.38.

#### 3.4.4.2 Operating Power Characteristics

The FAA systems, in which all lamps defined by this specification are operated, power each lamp with 60Hz. alternating current (AC). Multiple tap transformers supply voltage. The total harmonic distortion of the fundamental (60Hz) frequency (THDF) of this voltage shall be considered as eight percent (8%) for lamp design purposes.

#### 3.4.5 Life

The life of voltage-regulated lamps to be provided in accordance with this specification is defined by FAA drawing DE-B-3390A.

The terms; rated life, average life, rated average life, and average rated life, shall all be considered as defining the same period of time. Lamps defined by this specification shall have a rated life of two thousand (2,000) hours. Offers with greater, or lesser, rated life hours will be considered.

All lamp design offers shall include the standard deviation ( $\sigma$ ) of lamp life hours and rated life hours for the specific lamp design offered.

The basic equation for the cost of ownership of lamps is:

$$\text{\$} = N(.xxx)(\text{\$L})(\text{SL}\text{\$}) + N(\text{\$L})(\text{GL}\text{\$})$$

N equals the number of lamps in the specific system.

.xxx equals the decimal equivalent of sigma, or the decimal of the percentage of lamps expected to fail at the point in time.

\\$L equals the cost of the lamp.

SL\\$ equals the cost of spot replacement for a single lamp.

GL\\$ equals the cost per lamp for group re-lamping the entire system.

The cost of ownership of each offered design will be calculated from the minus three, sigma ( $-3\sigma$ ) value to rated life for the specific design using the offered lamp price, and lamp numbers and re-lamping costs appropriate to the system.

#### 3.4.6 Candela Maintenance

The lamp beam candela output after the hours of full power operation required to attain the minus three-sigma ( $-3\sigma$ ) life of the submitted lamp design shall be no less than ninety percent (90%) of the initial beam candela output.

#### 3.4.7 Lamp Dimensions

PAR-38

#### 3.4.8 Environmental Requirements

##### 3.4.8.1 General

Lamps shall operate in FAA holders, in the range of environmental conditions specified. Tungsten-Halogen lamps shall operate as a halogen cycle lamp in the range of environmental conditions specified.

##### 3.4.8.2 Temperature

Any ambient air temperature between  $-60^{\circ}\text{F}$  ( $-51^{\circ}\text{C}$ ) and  $+120^{\circ}\text{F}$  ( $+49^{\circ}\text{C}$ ).

##### 3.4.8.3 Altitude

Any altitude from sea level to 10,000 feet (3,048 meters) above sea level.

##### 3.4.8.4 Humidity

Any relative humidity between zero and one hundred percent (0% to 100%) over the ambient air temperature range specified.

##### 3.4.8.5 Vibration

Lamp design shall be one for vibration service. The diversity of FAA lamp holder mounting is such that specific frequencies and amplitudes cannot be defined. Structures usually resonate at relatively low frequencies.

Lamps shall have no harmonic resonance of the filament, when power is off or applied at any operating value, over a frequency range of one (1) to one thousand (1,000) Hertz.

Harmonic resonance, as used herein, means these parts exhibit an increase in physical movement at a specific frequency, analogous to a vehicle (filament) vibrating from an out of balance tire (propeller harmonic).

MIL-STD-810F Method 514.5, VIBRATION, Procedure I and Method 516.5, SHOCK, Procedure I, provide rationale and guidance for the necessary three (3) axis testing. Additional guidance may be found in ASTM D 3580 and ASTM D 5112.

#### 3.4.8.6 Salt Fog

Exposure to salt laden atmosphere.

#### 3.4.8.7 Cold Rain

Exposure to wind-blown cold rain.

#### 3.4.8.8 Sand and Dust.

Exposure to wind blown sand and dust.

### 3.5 Historical Information

The first MALS system used standard 150-watt, 120 volt, incandescent, PAR lamps. The EPA/DOE mandate to cease production of this energy inefficient standard design, and the economic impact of removal of arsenic from the glass making process, combine to require a definition of performance need for this lamp application. Standard tungsten-halogen cycle lamps cannot be mass-produced to withstand the operating environment of this airfield application.

### 3.6 Optional Designs

The basic criteria for optional designs are:

Function, voltage input and light output match the requirements of this specification, and existing systems.

Fit, lamps fit in the existing systems.

Form, is recognizable as a light source.

Optional designs will be considered and may be approved by the procuring authority.

## 4.0 QUALITY ASSURANCE PROVISIONS

### 4.1 Quality Control by Contractor

As a minimum, the manufacturer of lamps furnished in accordance with this specification shall have and maintain a quality control program in accordance with ISO 10005, Quality management - Guidelines for quality plans.

ISO 9001 or ISO 9002 registration of the lamp manufacturer will be accepted as verification of the required quality control program. The FAA may audit the manufacturer's quality control program at its sole discretion. All contractors shall provide either proof of the manufacturer's ISO registration or a copy of the manufacturer's quality control plan.

### 4.2 Government Inspection

The term "government inspection" used in this specification includes, but is not limited to: inspection for the government by a qualified laboratory, FAA witnessing contractor's testing, FAA testing, and FAA inspection, as deemed necessary to verify compliance with the requirements of this specification and all requirements of the contract.

The words "defect" and "nonconformance" shall be used interchangeably, as are "rejected" and "nonconforming". Critical items are those that are cause for rejection. Major items are those that may be corrected by the contractor and, in general; do not usually affect the life or performance of the lamp.

#### 4.2.1 Critical Defects or Nonconformances

Any cracking, separation, or fracture of the lens, cover, body or assembly of the lamp. Failure to operate as a lamp. Failure to deliver and maintain the minimum specified light output and distribution of light output. Failure to meet the rated life of the specific lamp design. Any failure to meet specified performances of the qualification tests for the lamp type. Lamp size or shape not as specified.

#### 4.2.2 Major Defects or Nonconformances

Packaging, packing, dirty lamp interior, markings not permanent, and screw base corroded.

### 4.3 Qualification Testing

Qualification testing is the process of verifying offered lamp designs meet the requirements of this specification. The requirements of this specification are the

minimum requirements for qualification of each specific lamp design. Offered lamp designs which pass qualification testing will be designated as a qualified product.

The critical and major defects listed in 4.2.1 and 4.2.2 apply to all qualification tests in addition to the specific requirements of the test(s). Sequential numbers shall individually identify all lamps in each submitted qualification sample. These lamp numbers shall be referenced for the duration of testing.

The hours of full power operation of each lamp shall be recorded for each specific test requiring full power operation. These recorded hours shall be included in the total hours of full power operation for the Life and Candela Maintenance Test, reference 4.2.5.6.

A qualified independent testing laboratory employed by the FAA will perform qualification testing. The contractor shall submit twenty-two (22) samples of each offered lamp design for qualification tests.

The qualification samples will be returned to the offering contractor at the completion of testing with a copy of the test results for the contractor's qualification sample.

#### 4.3.1 Qualification Testing of Lamps

Twenty (20) of the twenty-two (22) submitted design qualification sample lamps will be randomly selected for the specific tests required. All twenty (20) lamps shall pass these ten (10) tests to become a qualified product.

The remaining submitted sample lamps will be used as replacements for any lamps accidentally damaged or destroyed during testing. If the testing laboratory damages or destroys more than two (2) submitted sample lamps from any lot of twenty-two (22) the contracting officer may allow the submitting contractor to furnish replacements.

#### 4.3.2 Qualified Lamps

Qualified lamp designs shall remain qualified unless disqualified as a result of the inspection and testing of section 4.4 or the defining FAA specification is changed. The FAA may elect to re-qualify all lamps in the future.

#### 4.4 Acceptance Testing

Acceptance testing is the process of verifying qualified lamps supplied to the FAA are being manufactured to meet the lamp design performance capability verified by qualification testing. Acceptance of all lamps is at destination. The FAA, or agents of the FAA, shall at the sole discretion of the FAA, test and inspect all lamps received on a lot basis. Acceptance inspection will be done at the sole discretion of the FAA.

A lot is hereby defined as all lamps of one qualified design and source received at the same time and day and listed on one (1) transportation document by the carrier. These lots will be tested on a sampling basis in accordance with ANSI/ASQCZ 1.4-1993. The Acceptable Quality Level, AQL, is 1.0 for all lamps defined by this specification.

The Inspection Level will begin with Level I. The inspection level will be adjusted according to the switching rules for the ANSI Z1.4 system defined by Figure 1 of Z1.4. Reduced inspection shall be Level S-4 and tightened inspection shall be Level II.

#### 4.4.1 Waiver of Acceptance Testing

Inspection of finished products is an added cost. Contractors whose manufacturing process contains a documented and auditable multiple year record of manufacturing and delivering like products with an equal or lower rate of non-conformance ( $AQL \leq 1.0$ ) may request a waiver in their proposal.

The FAA will audit the contractor's records. The audit may include witnessing the manufacturing process. When the FAA grants a waiver of acceptance testing, the contractor shall supply Certificates of Conformance. Each and every lot shipped to the FAA will include the Certificate for that lot. A duplicate Certificate will be mailed or electronically transmitted to the Quality and Reliability Officer (QRO) assigned to monitor the acquisition. The Contracting Officer issuing the formal documents for the acquisition will identify the QRO in the formal documents.

A responsible employee of the contractor shall sign all Certificates of Conformance. The contractor shall furnish a current list of authorized individuals to the FAA Contracting Officer. The certificates of conformance shall identify the number of lamps, identified by their date of manufacture and ordering designation, in each lot shipment.

#### 4.4.2 Acceptance Tests

All lots will be visually inspected for transit damage. Inspection of the samples selected for acceptance testing will include; marking, packaging, concealed damage, physical dimensions and specified cleanliness of the lamp.

Acceptance testing will normally consist of: Photometric Tests, Wattage/Rating Test, and Short Term Overload Test and The FAA shall at its sole discretion, expand acceptance testing to include any other, or all, qualification tests.

#### 4.4.3 Acceptance Inspection/Testing and Disqualification

The FAA will begin acceptance inspection and testing at inspection Level I sampling rates and anticipates reducing the level of inspection to Level S-4. The Switching Rules for ANSI Z1.4, Figure 1, are modified as follows: If the Inspection Level is increased from Level I to Level II, the non-acceptance of 3 consecutive lots constitutes Disqualification of the lamp. All expenses for re-qualification of the lamp shall be borne by the contractor. An independent testing laboratory accepted by the cognizant FAA contracting officer shall re-qualify the lamp design.

#### 4.4.4 Nonconforming or Rejected Lots

All lots found nonconforming by acceptance inspection and/or testing are the sole responsibility of the contractor, at the place of inspection or testing, when found nonconforming. The FAA, at its sole discretion, may elect to accept portions of nonconforming lots.

### 4.5 Test Methods

#### 4.5.1 General

Testing of all lamps shall be as defined in this specification. Unless specified differently in a specific test, the following General Laboratory Test Method Guidelines, of section 5. of MIL-STD-810F, shall be followed: 5.1 Standard Ambient Test Conditions., 5.2 Tolerances for Test Conditions., 5.3.1 Suitability for environment., 5.3.2 Calibration., 5.4 Stabilizing Test Temperature, 5.4.1 Test item operating., 5.4.2 Test item non-operating., 5.8.1 Installing the test item in test facility., 5.8.2 Test item operation., 5.10 Information during Test., All of 5.11 Interrupted Tests including 5.11.1, 5.11.2, 5.11.3., 5.16 Water Purity., and 5.18.1 Monitoring test chamber parameters. All other requirements of aforementioned section 5 are specifically excluded.

The tests required by this specification are those that represent the operating environment for the specific lamp. Historically there has been an overemphasis of higher temperature operation for tungsten-halogen lamps. The inherent characteristics of tungsten-halogen lamps require elevated internal temperatures to achieve the halogen cycle.

The successful use of tungsten-halogen lamps in the colder geographic areas of FAA operation have historically created a standing order to maintain the lamps energized at their lowest input power level. The low temperature test includes a photo metrics test to define the response of each offered design and validate the order to maintain continuous lamp power in cold conditions.

#### 4.5.1.1 Physical Mounting

All Severe Environmental Tests (4.5.2.6) and the Cold Rain Test (4.5.2.5) shall be performed with the lamp mounted in a FAA holder. All other testing of lamps shall be done in fixtures, jigs or holders appropriate to the specific test or sequence of tests.

#### 4.5.1.2 Test Voltage and Current

Lamps furnished to conform to the requirements of this specification shall be tested for qualification and acceptance with sixty hertz (60Hz) alternating current power containing three percent (3%) total harmonic distortion, or less, of the fundamental (60Hz) frequency ( $\leq 3\% \text{THDF}$ ).

Copper wire, minimum American Wire Gauge (AWG) according to the following table shall be used from the terminals of the power supply to the connector to the lamp base.

Maximum Distance by wire length:	20 feet	30 feet	50 feet
Minimum Wire AWG:	#10 AWG	#8 AWG	#6 AWG

Application of full rated power for all lamps shall be a step application.

#### 4.5.1.3 Initial Conditioning (Burn-in)

All lamps will be conditioned prior to testing. Each offered design shall be conditioned as a group. Conditioning will consist of full power operation for one percent (1%) of the rated life of the lamp design, i.e. a 2,000-hour rated life lamp would be operated at full power for twenty (20) hours. The lamp shall be operated with sixty-hertz (60Hz) alternating current and the voltage shall be controlled within a range of plus zero percent (+0%), minus one percent (-1%) of rated voltage.

#### 4.5.2 Specific Tests

##### 4.5.2.1 Wattage Rating Test

The lamp shall be operated at full rated power for fifteen (15) minutes prior to wattage measurement. All lamps shall be consistently and uniformly shielded from air movement other than the convection movement created by the lamp itself during this test.

Power supply voltage shall be set to rated lamp voltage after these fifteen (15) minutes and not changed during the lamp wattage measurement. The power supply voltage shall be regulated within one-tenth percent (1/10%) of setting.

Lamp actual wattage is defined as the average watts measured over a one (1) minute interval. Maximum and minimum watts shall also be recorded during this one-minute interval.

The average of all actual lamp wattages measured in each submitted sample shall establish the wattage rating for the submitted design.

Instrument accuracy shall be a plus or minus one-tenth of one percent ( $\pm 0.1\%$ ) of reading, or better. The measured current and voltage values shall be continuously recorded or logged during the one (1) minute measurement interval.

Voltage shall be measured directly at the lamp base, not at any type connector used to connect the power leads to the lamp.

#### 4.5.2.2 Photometric Tests

Photometric tests shall be conducted at rated power to validate compliance with the intensity and beam dimension requirements of Table I. Each lamp shall be energized at full rated voltage, and operated at full voltage until it is as stable as demonstrated during the wattage-rating test. The photometric measurements shall not begin until this stability is demonstrated.

After the beam dimension and intensity measurements at rated power, without removing or disturbing the lamp, compliance with the requirements for Candela Output over Operating Power Range shall be verified.

The input voltage shall be reduced to 75 and 50 volts respectively and the beam pattern and intensity measured at each input voltage value. The lamp shall remain in the test fixture for the overload and photometric test.

#### 4.5.2.3 Overload and Photometric Test

The test chamber ambient air temperature shall remain as specified by the Photometrics Test. The lamp shall be operated for one hundred twenty (120) seconds at 110% rated voltage immediately following the completion of the Photometrics Test.

The lamp input power shall then be reduced to rated and operated for fifteen (15) minutes. A Wattage Rating measurement (one minute) shall be repeated immediately following this 15-minute equalizing period. Photometric measurements shall be made to define the results of the overload test.

Failure is defined as any one or more of the following:

- A. Destruction of the filament.
- B. Distortions of the filament resulting in a one degree ( $1^\circ$ ), or greater, change in the center axis of the beam in either the vertical or horizontal position.
- C. Change in beam size and/or intensity greater than two percent (2%).
- D. Wattage rating measurement differing more than one percent (1%) from previous measurement.

#### 4.5.2.4 Low Pressure Test

The low-pressure test shall be conducted in accordance with MIL-STD-810F, Method 500.4, Procedure II. The lamp shall be tested at atmospheric pressures corresponding to 10,000 feet (3,048 meters) altitude. Lamps shall be tested at  $-60^\circ\text{F}$  ( $-51^\circ\text{C}$ ).

Lamps shall be tested for a total of six cycles of rated power operation with a power off interval with the test chamber pressure and temperature maintained constant. A cycle is defined as operation for one (1) hour at rated power, followed by one-half ( $1/2$ ) hour off. Refer to section 4.5.1.2 for power application details.

Photometrics measurements shall be made to define any change in lamp output. The A, B, C and D requirements of the Overload Test also apply to the Low Pressure Test.

#### 4.5.2.5 Cold Rain Test

This test shall be conducted in accordance with MIL-STD-810F, Method 506.4, Procedure I. Rainfall rate shall be four (4) inches per hour driven at a velocity of forty miles per hour (40mph)(18 m/s). The rain shall be directed to strike the lamp face parallel with the mechanical axis of the lamp, perpendicular to the lens surface plane in other words.

The lamp shall be mounted in an FAA lamp holder with its longitudinal mechanical axis tilted  $10^\circ$  upward (lamp  $10^\circ$  base down). The lamp shall be operated with rated voltage in a one hundred degree Fahrenheit plus or minus two (2) degrees Fahrenheit ( $+100^\circ\text{F} \pm 2^\circ\text{F}$ )( $+38^\circ\text{C} \pm 1^\circ\text{C}$ ) ambient air temperature environment.

The lamp shall then be sprayed four (4) times with water having a temperature of  $+32^\circ\text{F}$  to  $+34^\circ\text{F}$  (0 to  $+1^\circ\text{C}$ ) for fifteen (15) seconds at four intervals. The first spray shall be done fifteen (15) minutes after the lamp is energized, the second spray after thirty (30) minutes, the third after forty five (45) minutes, and the fourth at one (1) hour of full power operation. This is a thermal shock resistance test.

In addition, when there is a coating on the lens or cover, the adhesion test defined in Severe Environmental Tests (4.5.2.6) shall be performed when the lamp has cooled to laboratory ambient temperature.

#### 4.5.2.6 Severe Environmental Tests.

Tests shall be conducted on the lamp as defined in the subparagraphs below. At the completion of each test, the lamp shall be thoroughly examined for defects.

The Icing Test, High Temperature & Humidity Test, Low Temperature Test, Sand and Dust, and Salt Fog Test shall all include the following coating adhesion test that shall be performed on any coated lens or coated cover lamp.

Cut a one-inch (1") square into the surface coating. Adhesive tape, commercial item A-A-883 (NSN 7510-01-031-3129) shall be placed centered over the square cut into the surface and removed after five minutes. The adhesive tape shall be of sufficient length to allow removal with the removing force applied at right angles to the surface. Any peeling of the lens protective coating, from the area under the tape, or visible anywhere on the lens surface, constitutes failure of the test.

##### 4.5.2.6.1 Sand and Dust Test.

The sand and dust test shall be performed in accordance with Method 510.4 of MIL-STD-810F. Blown dust concentration as specified by 2.3.2.6.a. Blowing sand as specified by 2.3.2.6.b (2). Test Durations as specified by 2.3.2.8. Lamp energized at full rated power. Lamp shall not lose more than 5% beam candela intensity. Beam pattern size shall not change more than 5% in size in either height or width.

##### 4.5.2.6.2 Salt Fog Test.

The salt fog test shall be performed in accordance with Method 509.4, of MIL-STD-810F. The lamp shall be exposed for a total of eighty-six (86) hours. Four consecutive periods of twelve (12) hours wet, twelve (12) hours dry.

The lamp shall be energized at rated power for the duration of the test. Lamp shall not lose more than 5% beam candela intensity. Beam pattern size shall not change more than 5% from initial value. The coating adhesion test shall be performed when applicable.

##### 4.5.2.6.3 Icing Test.

The icing test shall be conducted in accordance with Procedure I of Method 521.2 of MIL-STD-810F. Lamps shall be mounted as specified in section 4.5.1.1 for this test, lamp ten degrees (10°) base down.

The lamp and FAA holder shall be placed in an thirty degree Fahrenheit environment ( $+30^{\circ}\text{F} \pm 2^{\circ}\text{F}$ ) ( $-1^{\circ}\text{C} \pm 1^{\circ}\text{C}$ ) until cooled to this temperature. Water shall then be introduced by suitable means to cause a layer of glaze ice to form on the lamp covering the lens or cover to a thickness of at least one half inch ( $1/2''$ )(1.27cm).

After the required thickness of glaze ice has formed, the ice coated lamp temperature shall be reduced to minus thirty-two degrees Fahrenheit ( $-32^{\circ}\text{F} \pm 2^{\circ}\text{F}$ )( $-35.5^{\circ}\text{C} \pm 1^{\circ}\text{C}$ ). The lamp shall be energized with rated current and allowed to operate until the ice melts off. The lamp shall then be de-energized, removed from the holder, and examined for defects.

A center of beam intensity measurement shall be made. This intensity shall equal the previously measured intensity for the specific lamp in the submitted lot at the conclusion of the Salt Fog Test. The coating adhesion test shall be performed when applicable.

#### 4.5.2.6.4 Low Temperature Test.

Lamps shall be mounted in an FAA holder angled ten degrees ( $10^{\circ}$ ) up (lamp  $10^{\circ}$  base down) for this test as specified by section 4.5.1.1.

The low temperature test shall be conducted in accordance with Procedure II, Method 502.4 of MIL-STD-810F. The temperature shall be constant. Lamps shall be tested at minus sixty degrees Fahrenheit plus or minus two (2) degrees ( $-60^{\circ}\text{F} \pm 2^{\circ}\text{F}$ )( $-51^{\circ}\text{C} \pm 1^{\circ}\text{C}$ ). Test chamber test temperature shall be maintained for a period of six (6) hours prior to energizing the lamp. Temperature sensors shall be installed around the lamp in the test chamber.

The lamp shall be energized at rated power, refer to section 4.5.1.2, Test Voltage and Current. The test chamber temperature shall be maintained at minus sixty degrees Fahrenheit ( $-60^{\circ}\text{F}$ ).

A single point, center of beam, measurement of candela shall be made continuously from the time the lamp is energized until the candela has reached the value previously established for the individual lamp by the Icing Test. The time to reach this beam candela value shall be recorded.

If a specific lamp does not reach the specified candela value the test shall be ended when there is no longer an increase in candela of the specific lamp.

The coating adhesion test shall be performed when applicable.

#### 4.5.2.7 Life and Candela Maintenance Test

The hours of full power operation of each lamp during previous testing shall be included in the total operating hours of each lamp for this test. Reference section 4.3, Qualification Testing.

Ambient air temperature shall be fifty-four degrees Fahrenheit plus or minus five degrees Fahrenheit ( $54^{\circ}\text{F}\pm 5^{\circ}\text{F}$ ) ( $10^{\circ}\text{C}\pm 2.8^{\circ}\text{C}$ ). Ambient air temperature of the test chamber shall be maintained as specified for the duration of all life tests.

The life test shall be done with cycled or interrupted power to the lamp. Refer to section 4.5.1.2, Test Voltage and Current. The lamp shall be operated for twelve (12) continuous hours at full rated power. Power shall then be turned off for a period of one (1) hour. Full rated power shall then be reapplied for twelve (12) more hours. This cycle of 12 hours on, 1 hour off, shall continue until all twenty (20) lamps, fail due to filament failure.

The life test power cycle shall include a Photometric Test and verification of the marking requirement durability of section 3.4.

At the minus three sigma ( $-3\sigma$ ) hours of rated power operation of the submitted design, the beam candela output shall not be less than ninety percent (90%) of the initial candela established for the individual lamp by the Photometric Test.

The life test shall include a continuing measurement of individual lamp wattage. Beginning at the offerer's stated  $-3\sigma$  hours of operation; individual lamp current shall be measured and recorded. This current measurement shall be made, on every lamp, at the midpoint of every twelve (12) hour power on cycle of the life test.

The testing laboratory shall perform a statistical analysis of the results of the life test for each submitted qualification sample.

## 5.0 PREPARATION FOR DELIVERY

### 5.1 General

Lamps shall be packaged for extended warehouse storage and reshipment. Packaging shall be in accordance with ASTM D 3951. Testing or validation shall be in accordance with ASTM D 4169, Assurance level II, and Distribution cycle 18.

### 5.2 Packaging

Each lamp, with minimum one (1) inch cushioning, shall be packaged in an individual (unit package) fiberboard container.

Unit packages shall be over packed in intermediate containers with twelve (12) unit packages per container.

Intermediate packaging and shipping containers shall be capable of multiple handling and storage under favorable conditions, such as enclosed facilities, for a minimum of one year.

### 5.3 Palletized Shipments

All palletized shipments shall be made on disposable pallets whose maximum outside dimensions are forty-seven and one-half inches (47 ½") by forty inches (40"). Overall height of the pallet and contents shall not exceed forty-seven inches (47"). Fork entry of the pallet shall be on the long sides of the pallet. No portion of the load shall overhang or extend beyond any pallet edge. Shrink-wrapping to secure intermediate containers is encouraged.

### 5.4 Marking

Unit and intermediate packages, shipping containers and palletized loads shall be marked in accordance with MIL-STD-129L. Unless specifically required by other contract documents or purchase order requirements, bar coding in accordance with MIL-STD-129L (Reference appendix H, 20.1, 20.7, 20.8, 20.9, and 20.10) shall not be applied.

The appropriate marking order is:

National stock Number (NSN)  
CAGE Code and Part Number  
Item description  
Quantity and Unit of issue  
Contract or Purchase Order number  
Level of protection and Date Packed  
Rated Life Hours  
Sigma Hours

## 6.0 NOTES

The contents of the subparagraphs below are only for information. They are not contract requirements, and are not binding on either the Government or the contractor except to the extent that they may be specified as such in other contract documents. Any reliance placed by the contractor on the information is wholly at the contractor's own risk.

6.1 Government Furnished Equipment

None.

6.2 Packaging Testing

It is recommended the contracting officer direct initial shipment of all qualification samples to themselves. When all qualification samples are received, one carrier, in one shipment, should transport all the samples to the independent testing laboratory. The receiving testing laboratory should inspect the packing and packaging as received for conformance and effectiveness.

### **Table I. Minimum Lamp Requirements**

The beam axis for all lamps shall be within one-half degree ( $\pm 1/2^\circ$ ) of the mechanical axis of the PAR-38 bulb. Operating position for all lamps shall be from horizontal to forty-five degrees ( $45^\circ$ ) base down. All candela intensity measurements shall be made at a minimum distance of twenty (20) feet from the lamp centerline.

Rated voltage = 120.

Maximum nominal wattage rating in watts = 150.

Color Temperature approximately  $3000^\circ\text{K}$  at rated power.

Bulb = PAR-38.

Base = Medium skirted.

Initial Beam Lumens = 1100.

Initial total Lumens = 1735.

Approximate Beam Spread in Degrees =  $30 \times 30$ .

Average Candela in Central 10 degree ( $10^\circ$ ) Cone = 11,000.

Rated Life = 2,000 hours.

