FAA-E-2952
Date: 2/25/03

U.S. DEPARTMENT OF TRANSPORTATION

FEDERAL AVIATION ADMINISTRATION

DETAIL SPECIFICATION

APPROACH LIGHT, CHEMICAL RESISTANT, HIGH INTENSITY, SEMI-FLUSH, STEADY BURNING

Product Team for Navigation and Landing
Systems, AND-740

1. SCOPE AND CLASSIFICATION

1.1 Scope.- The equipment covered by this specification is a chemical resistant(runway deicer/anti-icer), high intensity, semi-flush, steady burning approach light unit to be used in paved operational surfaces of runways normally used by aircraft and airport service vehicles.

1.2 Classification.- Two types and three styles of semi-flush approach lights are covered by this specification.

1.2.1 Type.- Semi-flush lights with the following electrical characteristics are covered by this specification:

Type I	500 watts 6.6 amps
Type II	500 watts 20 amps

1.2.2 Style.- Semi-flush lights of the following styles are covered by this specification:

Style A	White light
Style B	Green light (Threshold)
Style C	Red light

1.3. Features.- To ensure maximum performance, the following features are included:

(a)Installation on L-868 light base
(b)Maximum input power to the light unit is 500 watts
(c)Resistance to runway de-icers and anti-icers is required
(d)Stainless steel or aluminum is required for the top cover
(e)12 minutes is maximum time for lamp replacement
(f)Maximum weight of the light unit is 44 pounds
(g)1/2″ is the maximum projection above the runway pavement
(h)1/16" is the minimum radius on exposed exterior surfaces
(i)Maximum slope of the top surface is 12^0
(j)An internal flange to restrain each lens is required or alternatively a wedge shaped lens and mating aperture
(k)Torqueing instructions provided via metal plate

2. APPLICABLE DOCUMENTS

2.1 FAA Documents.- The following FAA specifications and Advisory Circulars of the issues specified in the invitation for bids or screening information request, form a part of this specification and are applicable as specified herein.

2.1.1 FAA specifications.

FAA-D-2494	Technical Instruction Book Manuscripts; Electronic, Electrical, and Mechanical Equipment, Requirements for Preparation of Manuscript and Production of Books
FAA-G-2100	Electronic Equipment, General Requirements

2.1.2 FAA Advisory Circulars.

AC 150/5345-26	Plug and Receptacle, Cable Connector
AC 150/5345-42	Airport Light Bases, Transformer Housings, Junction Boxes, and Accessories
AC 150/5345-47	Isolation Transformers for Airport Lighting Systems
AC 150/5345-53	Airport Lighting Equipment Certification Program

2.2 Military and federal publications.- The following military and federal publications, of the issues of the issues specified in the invitation for bids or screening information request, form a part of this specification and are applicable as specified herein.

2.2.1 Military specifications.

MIL-A-8625	Anodic Coatings for Aluminum and Aluminum Alloys
MIL-C-7989	Covers, Light Transmitting, for Aeronautical Lights, General Specification for
MIL-DTL-13924	Coating, Oxide, Black, for Ferrous Metals

2.2.2 Military standards.

MIL-STD-276	Impregnation of Porous, Non-Ferrous Metal Castings
MIL-STD-810	Environmental Test Methods and Engineering Guidelines
MIL-STD-889	Metals, Definition of Dissimilar

2.2.3 Federal specifications.

ZZ-R-765	Rubber, Silicone; Low and High Temperature and Tear Resistant

2.2.4 Federal standards.

FED-STD-123	Marking for Shipment (Civil Agencies)

2.3 Other standard documents.- The following industry publications, of the issues specified in the invitation for bids or screening information request, form a part of this specification and are applicable as specified herein.

ANSI/ASQC Z1.4	Sampling Procedure for Inspection by Attributes
ANSI/ASQC-Q9003	Quality Systems, Model for Quality Assurance In Final Inspection and Test (1994)
ANSI B46.1	Surface Texture (Surface Roughness, Waviness, and Lay)
ASTM A890/A890M	Standard Specification for Castings, Iron-Chromium-Nickel-Molybdenum Corrosion-resistant, Duplex (Austenitic/Ferritic) for General Application
ASTM D3951	Standard Practice for Commercial Packaging
ASTM D4169	Standard Practice for Performance Testing of Shipping Containers and Systems
IES LM-35	Photometric Testing of Floodlights Using Incandescent Filament or Discharge Lamps
SAE-AMS-A-21180	Aluminum-Alloy Castings, High Strength
SAE-AS25050	Colors, Aeronautical Lights And Lighting Equipment, General Requirements For

Copies of this specification and other applicable FAA publications may be obtained from the Contracting Officer in the Federal Aviation Administration Office issuing the invitation for bids or screening information request. Requests should fully identify material desired, i.e., specification, standards, amendment, and drawing numbers. Requests should cite the invitation for bids, screening information request, or the contract involved or other use to be made of the requested material.

FAA Advisory Circulars may be obtained from the Department of Transportation, General Services Division, M-45, Washington, DC 20590: Phone (202) 267-3115, 3161, and 8329, or may be obtained electronically from http://www.faa.gov/arp/150acs.htm (Design, Construction & Maintenance).

Information on obtaining copies of federal specifications and standards may be obtained from General Services Administration offices in Atlanta; Auburn, Wash.; Boston; Chicago; Denver; Fort Worth; Kansas City, Mo.; Los Angeles; New Orleans; New York; San Francisco; and Washington, D.C.

ASTM documents may be obtained from American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428, or from: http://www.astm.org/cgi-bin/SoftCart.exe/STORE/store.htm?E+mystore.

American National Standards Institute/American Society for Quality Control (ANSI/ASQC) documents may be obtained from ASQC, 611 East Wisconsin Avenue, Milwaukee, Wisconsin 53202.

Single copies of military specifications and standards may be obtained from Federal Aviation Administration, Washington, D.C. 20590 Attn: Contracting Officer. Requests should cite the invitation for bids, screening information request, or contract for which the material is needed. Mail requests, if found acceptable, will be forwarded to a military supply depot for filling; hence, ample time should be allowed.

Military specifications and standards and federal and GSA specifications and standards may be downloaded from the Internet by accessing http://assist.daps.mil and then selecting the button for ASSIST Quick Search.

American National Standards Institute (ANSI) documents can be obtained electronically from http://webstore.ansi.org/ansidocstore/shopper_lookup.asp . Paper standards are available through Global Engineering Documents.

Society of Automotive Engineers (SAE) documents can be obtained from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Phone: (412) 776-4841.

Illuminating Engineering Society of North America (IESNA) documents can be obtained from IESNA at http://www.iesna.org/.

3. REQUIREMENTS

3.1 Equipment to be furnished by the contractor.- Each semi-flush approach light furnished by the contractor shall be complete in accordance with all specification requirements and shall be of the type and style as stated in the contract. Each semi-flush approach light of a specific type and style furnished under this specification on a given contract shall be identical with all other lights of the same type and style.

3.1.1 Light bases and transformers.- Light bases and transformers shall not be furnished with the light units. However, the contractor shall provide light bases and transformers for the testing described in paragraph 4. Power for the light will be obtained from a 20 ampere series circuit through an appropriate isolation transformer conforming to AC 150/5345-47. The transformer will be installed in the same light base as the light unit.

3.1.2 Interchangeability.- All individual parts of one light of a specific type and style shall be interchangeable with the same parts of all other lights of the same specific type and style.

3.2 General functional requirements.- The semi-flush approach light specified herein shall be designed for use in airport runways where it will be subjected to aircraft which are taxiing, landing and taking off, as well as airport service vehicles including snowplows and wire brush sweeping equipment. The light unit shall be designed for mounting in a Type L-868 light base, size B (see AC 150/5345-42). The light base will be used in a concrete or asphalt runway.

3.3 Environmental conditions.- The light shall operate under the following environmental conditions:
3.3.1 Temperature.- At any ambient temperature from -55°C (-67°F) to +55°C (+131°F).

3.3.2 Altitude.- Sea level to 10,000 feet above sea level.

3.3.3 Sand and dust.- Exposure to wind blown sand and dust particles as may be encountered in arid regions.

3.3.4 Corrosive fog.- Exposure to corrosive atmosphere containing salt laden moisture and potassium acetate laden moisture.

3.3.5 Humidity.– Up to 95 percent from sea level to 10,000 feet above sea level and +55°C (+131°F).

3.3.6 Rain.- Exposure to wind blown rain.

3.4 Materials and components.- Materials and equipment components shall be as specified herein. All parts of the light shall deter corrosion and oxidation when subjected to continuous operating temperatures in the confined atmosphere of the light base, and when exposed to chemicals typically present on the airfield, including but not limited to oil, gasoline, aircraft fuel, de-icing and anti-icing fluids.

3.4.1 Metals.- Metals shall withstand the mechanical stress involved and shall be inherently corrosion resistant or suitably protected as specified in paragraph 3.4.3, after fabrication, to prevent corrosion and oxidation under the service conditions. The use of dissimilar metals in contact with one another shall be avoided wherever practicable. However, if their use cannot be avoided, they shall be in accordance with MIL-STD-889. Stainless steel or aluminum shall be used for the top cover.

3.4.1.1 Stainless steel.- Stainless steel, if used for the top cover, shall meet the requirements of ASTM A890/A890M.

3.4.2 Hardware. - All bolts, studs, nuts, washers and other similar fasteners used in the light unit and base shall be fabricated from either 18-8, 410, or 416 stainless steel, passivated and free from discoloration. Lock washers shall be made of 410 stainless steel. Bolts subject to direct stresses resulting from forces applied to the top surface of the light unit shall be high strength corrosion resistant type Nitronic 60 stainless steel.

3.4.3 Protective coatings.- Protective coatings used for prevention of corrosion shall be as specified herein.

3.4.3.1 Anodizing.- Aluminum parts on the light which would be exposed to continuous moisture, salt laden moisture, or mechanical damage shall be Teflon penetrated hard coat anodized meeting the requirements of MIL-A-8625, Type III. Other aluminum parts shall be anodized per MIL-A-8625, Type I or Type II, Class 1 or Class 2 as applicable.

3.4.3.2 Black oxide finish.- Bolts or screws made of 410 or 416 stainless steel shall be given a black oxide finish in accordance with MIL-DTL-13924, Class 3, after heat treatment.

3.4.4 Glass.- Glass used as an optical or structural part shall comply with the requirements of this specification which includes the requirement of SAE-AS25050, Grade B and MIL-C-7989 for Class B and Class C glass (Class C glass may be used if required for impact strength). The light output windows shall

be of borosilicate glass, or equivalent, having an average Young's Modulus of 9.1×10^6 and a Poisson's Ratio of 0.2. The light transmission ratio shall be for aviation white and shall be equal to or better than Grade B. The glass shall be tempered to withstand the thermal shock specified in paragraph 3.5.5. Glass parts shall be supported in such a way that they will not be damaged by vibrations, shocks, or deflection of any component part.

3.4.5 Gaskets and O-Rings.- Gaskets and O-Rings used at separable joints shall be capable of sustained operation at temperatures specified in paragraph 3.3.1 and shall resist deterioration caused by de-icing or anti-icing chemicals. Gaskets and O-Rings shall be low compression set, silicone rubber conforming to ZZ-R-765, Class IIB Grade 60, or better, or neoprene.

3.4.6 Sealing compounds.- Compounds used for sealing shall be run proof and shall not harden or crack, shall remain mastic, and not lose water sealing properties after exposure under the specified environmental conditions and shall resist deterioration caused by de-icing or anti-icing fluids.

3.5 Design requirements.

3.5.1 General.- The light unit shall consist of a top cover, an optical assembly and a bottom cover.

The light unit shall be constructed so that adjustments and repairs can be made easily. All interior components of the light unit must be easily removable for cleaning or replacement. Normally available commercial tools shall be used for adjustments and repairs. Means shall be provided on the light unit to permit its removal for maintenance purposes, i.e. pry bar slots, indentations, extraction devices or other suitable provisions. The design shall allow removal of the light unit in not more than five (5) minutes, removal and replacement of the lamp(s), without the use of power tools, in not more than three (3) minutes and re-insertion of the light unit in not more than four (4) minutes (including tightening to the manufacturer’s recommended torques).

The light unit will be mounted on an L-868 light base, size B, on an 11.25 +/- 0.010 inch diameter bolt circle) with six 3/8 inch high-strength stainless steel bolts as specified in paragraph 3.4.2, using a silicone or neoprene O-ring. Interface details and dimensions of L-868B light bases are shown in AC 150/5345-42 (SPECIFICATION FOR AIRPORT LIGHT BASE, TRANSFORMER HOUSINGS, JUNCTION BOXES, AND ACCESSORIES). Critical interface areas of the light unit are the outer diameter, top flange, bolt holes and throat projection. The light unit shall have an outside diameter of 11.94 inches +/-0.05 inch. The light unit shall have a projection that extends at least 1/4 inch down through the top flange of the L-868B light base. The diameter of this projection shall be 9.95 inch +0.00/-0.01 inch. The light unit shall be designed to mount on an L-868B base whose top surface is 3/4 inch below grade. The light unit bolt-hole configuration shall match the top flange of the light base. In addition, the axis between one pair of bolt holes on opposite sides of the light unit must be perpendicular to the direction of the runway centerline.

Subject to approval of the Contracting Officer, it is also acceptable for the light unit to have an outside diameter less than of 11.94 inches. Such smaller light units will be used with adapter rings which shall be provided by the contractor. The contractor-provided adapter rings shall mate with the L-868 light base, size B, on an 11.25 +/- 0.010 inch diameter bolt circle with six 3/8 inch high-strength stainless steel bolts using a silicone or neoprene O-ring.

The contractor shall provide all necessary bolts, O-rings, washers and lock washers, as well as a quantity of anti-seize compound (28 grams minimum) with each light unit. The anti-seize compound shall be Loctite Nickel Anti-Seize Lubricant 771, or equal.

A plate, similar to the name plate, shall be attached to the bottom cover directing the installer to:

1. Apply anti-seize compound to each of the bolts attaching the light unit to the light base.
2. Torque the bolts to a value of from 175 to 200 inch-pounds, or the contractor's recommended value, if different.
3. Not use an impact wrench to tighten the bolts.

The light unit shall be airtight and watertight. Seals used shall prevent breathing with internal pressure changes due to varying lamp heat. Pressure within the light unit shall not exceed 20 pounds per square inch under any operating condition. If an inert gas is used within the sealed chamber to insure long life and efficient light output, ports shall be provided for purging and refilling. All parts shall be mounted in such a manner to insure withstanding shocks and vibrations under service conditions.

The light unit shall have a 30 inch long chemically resistant power lead, of the proper size, ending in a two pole, 20 ampere, Class A, Type II, Style 1 or Style 6, chemically resistant polarized plug connector as specified in AC 150/5345-26 (SPECIFICATION FOR L-823 PLUG AND RECEPTACLE, CABLE CONNECTORS). The design shall permit free standing of the light unit on a flat surface without interference from leads or other features.

The light unit shall not weigh more than forty four (44) pounds. The light unit shall not extend more than 12.5 inches into the light base (24 inches deep) measured from the top of the light base flange.

3.5.2 Top cover assembly.- The top surfaces of the light unit shall be stainless steel or aluminum and shall be smooth and free of sharp projections which could damage tires or engage with snowplow blades. Any O-ring grooves shall have a surface finish of 64 rms maximum as defined in ANSI B46.1. The surface on the light unit that mates with the light base flange shall have a smooth finish to provide good load transfer and sealing. The seating surfaces of the mating parts shall be flat to insure seating without rocking before being secured. No part of the top surface which protrudes above finished grade, excluding recesses, light windows and light channels, shall have a slope greater than 12 degrees. No part of the light shall exceed 1/2 inch in height above the pavement. All edges above the pavement shall be rounded to not less than 1/16 inch radius.

The top cover assembly may have one, two or three light windows. Each light window of the light unit shall have an internal flange that will prevent the lens from being pushed back into the interior of the light unit. The clearances between the lens and the metal surfaces of the light unit shall prevent cracking of the lens when the light unit is subjected to the specified loads. The clearances shall be chosen such that the possibility is minimized for shards of the Teflon/rubber snowplow blade edges to penetrate the area between the lens and the adjacent metal surfaces and cause leakage. Sealants or glues or other devices shall secure the lens in the light unit without leakage when subjected to the specified loads. To assure the integrity of seals and bonds after subjection to the specified loads, the sealants, glues, or other devices for securing the lens shall withstand chemicals typically present, including but not limited to oil, gasoline, aircraft fuel, de-icers and anti-icers.

A wedge shaped lens with appropriate retaining devices is also acceptable in lieu of an internal flange.

3.5.3 Optical assembly.- The optical assembly shall produce aviation white, aviation red, or aviation green light output, as required.

3.5.3.1 Lamp.- The optical assembly lamp(s) shall have a total wattage of 500 watts, or less. The average life of each lamp shall be greater than 1000 hours when operating in the optical assembly at maximum rated current. The light output during the final 10% of the lamp life shall be at least 90% of the initial light output. The optical assembly shall operate from a 60 Hz, regulated series circuit with pre-selected current values of 6.6, 5.2, 4.1, 3.4 and 2.8 amps (6.6 amp design), or 20, 15.8, 12.4, 10.3, and 8.5 amps (20 amp design). The lamp(s) shall meet all vibration, load and impact test requirements of this specification when installed in the optical assembly. Shock mounting shall be provided. The lamp(s) shall be selected for proper light output and shall be prefocused to insure consistency and repeatability of intensity and beam pattern with each lamp change. In order to prevent damage from all types of impact, the lamp(s) shall be securely seated in the optical assembly by a positive locking device.

3.5.3.2 Color filters.- Color filters may be used to produce the aviation white, aviation green or aviation red light outputs, as required. Mounts shall be designed to prevent the filters from cracking due to thermal shock, vibration or impact loads.

3.5.4 Light color, intensity and distribution.- Colors of the white, green and red light outputs shall conform to SAE-AS25050. The light units shall meet these chromaticity requirements at the maximum rated current. The intensity of the style A, B and C light patterns shall be required either to coincide with, or envelop the light patterns shown in Figures 1, 2, and 3. However, a one degree shift in the light pattern is permitted upward, left or right. A downward shift shall be not greater than 1/2 degree. The light pattern shall not cut off abruptly at the outer edges of the specified illuminated areas, but shall decrease gradually in intensity beyond the specified areas. If the light unit has a downward sloping light channel toward the light windows which could obstruct part of the window areas by water, the resulting light intensity with the obstructed portion of the windows blanked out must be at least 70% of the minimum value specified. Maximum intensity of the light units shall not exceed: Style A (white) - 48,000 candelas (CD); Style B (green) - 40,000 CD and Style C (red) – 24,000 CD.

3.5.4.1 Style A - White light output.- When the light unit is operated at maximum rated current, the light pattern shall be as shown in the isocandela curve in Figure 1. The 10,000 candela (CD) minimum value shall be required to enclose an area of at least 10° by 30° as follows: within 2° to 12° above horizontal and within 15° left to 15° right of the vertical centerline of the light unit. A slight infringement of lesser CD values is permissible, provided not more than 28 square degrees of the specified illuminated area (or light pattern) is affected with light intensity not less than 8,500 CD.

3.5.4.2 Style B - Green light output.- When the light unit is operated at maximum rated current, the light pattern shall be as shown in the isocandela curves in Figure 2. The 7,500 CD minimum value shall be required to enclose an area of at least 8° by 13° as follows: within 1.5° to 9.5° above horizontal and within 6.5° left to 6.5° right of the vertical centerline of the light unit. A slight infringement of lesser CD values is permissible, provided not more than 28 square degrees of the specified illuminated area (or light pattern) is affected with light intensity not less than 6,400 CD.

3.5.4.3 Style C - Red light output.- When the light unit is operated at maximum rated current, the light pattern shall be as shown in the isocandela curves in Figure 3. The 4,000 CD minimum values shall be required to enclose an area of at least 8° by 13° as follows: within 1.5° to 9.5° above horizontal and within 6.5° left to 6.5° right of the vertical centerline of the light

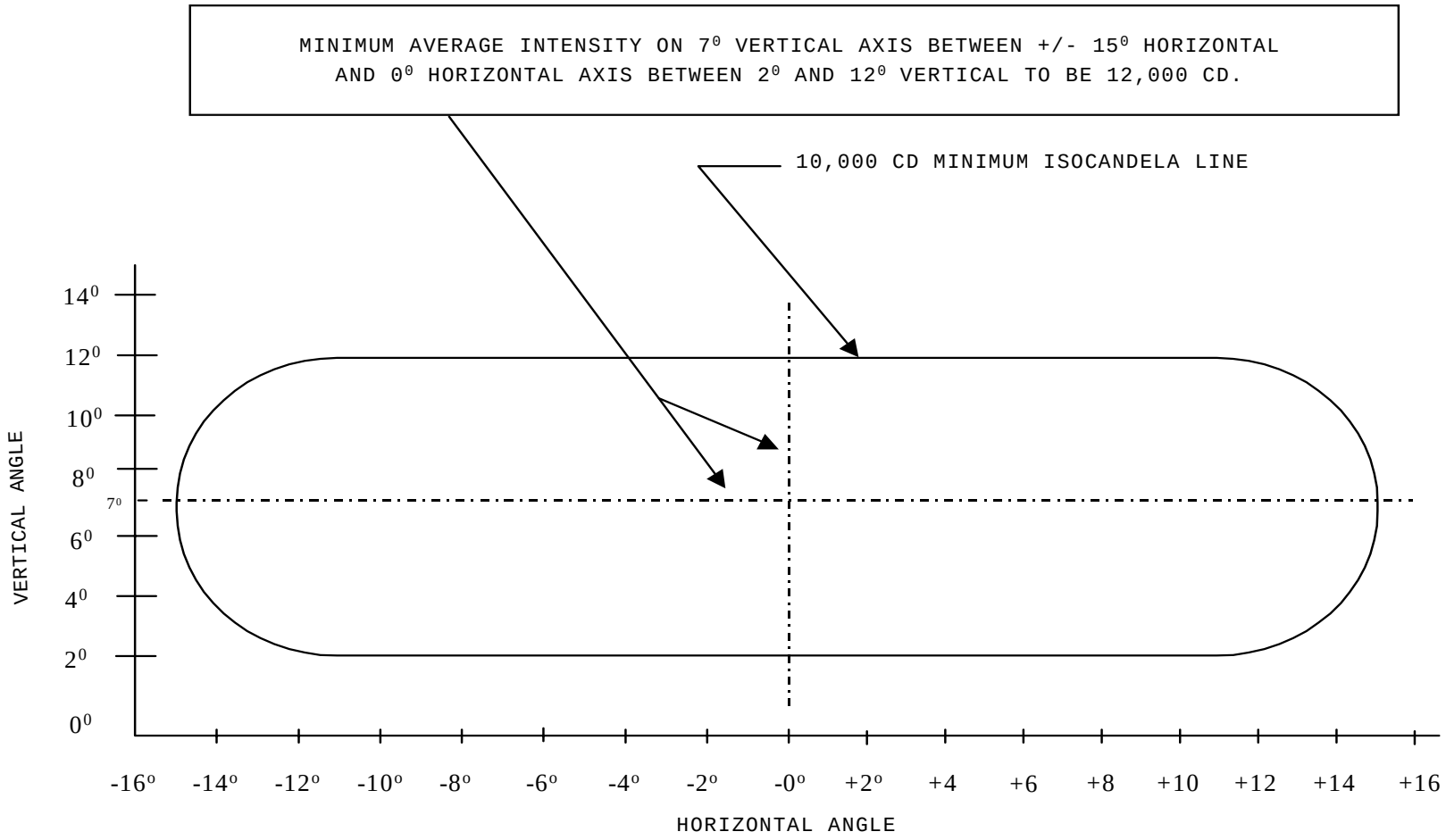

Figure 1. SEMI-FLUSH APPROACH LIGHT - STYLE A (WHITE)

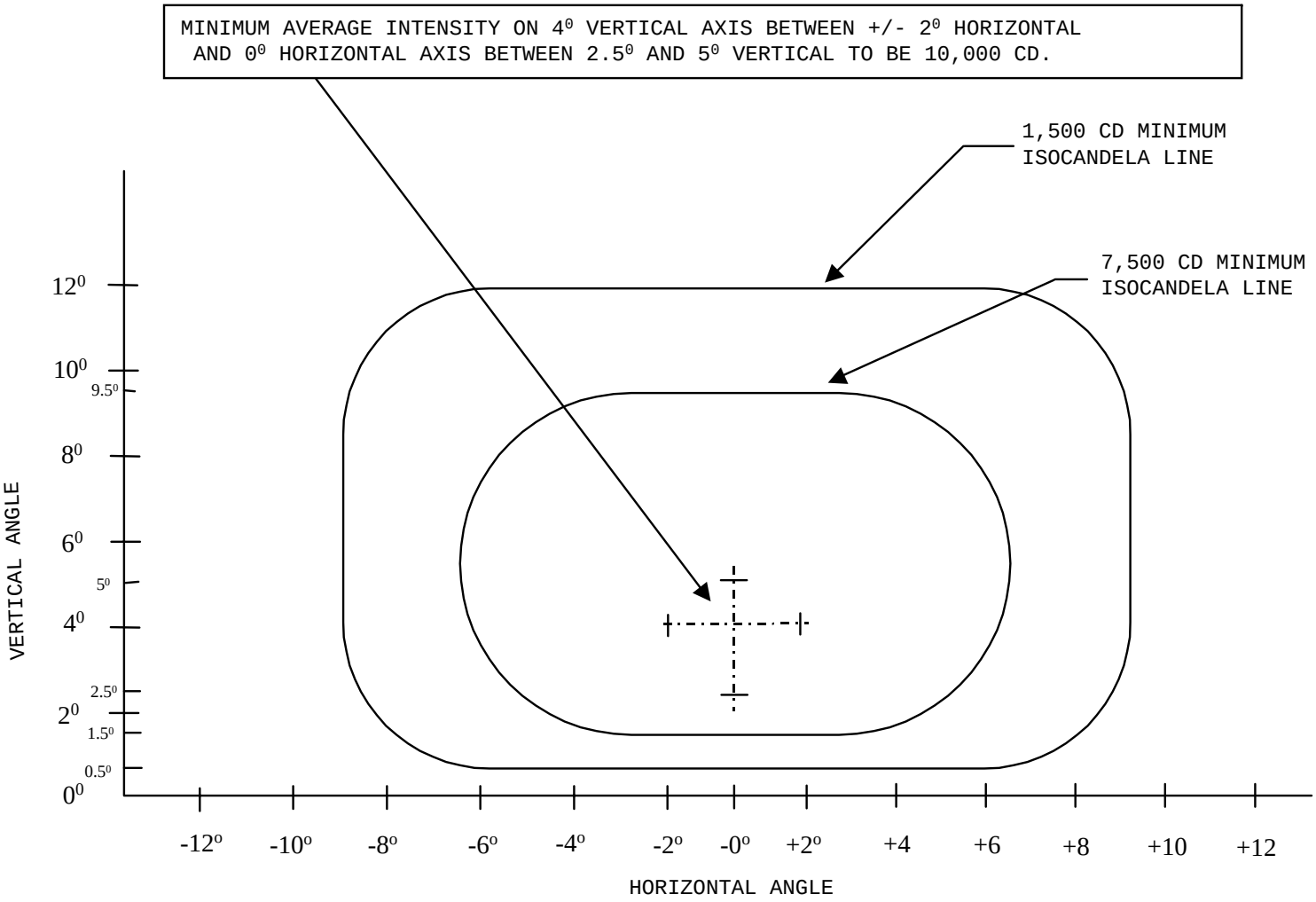

Figure 2. SEMI-FLUSH APPROACH LIGHT - STYLE B (GREEN - THRESHOLD)

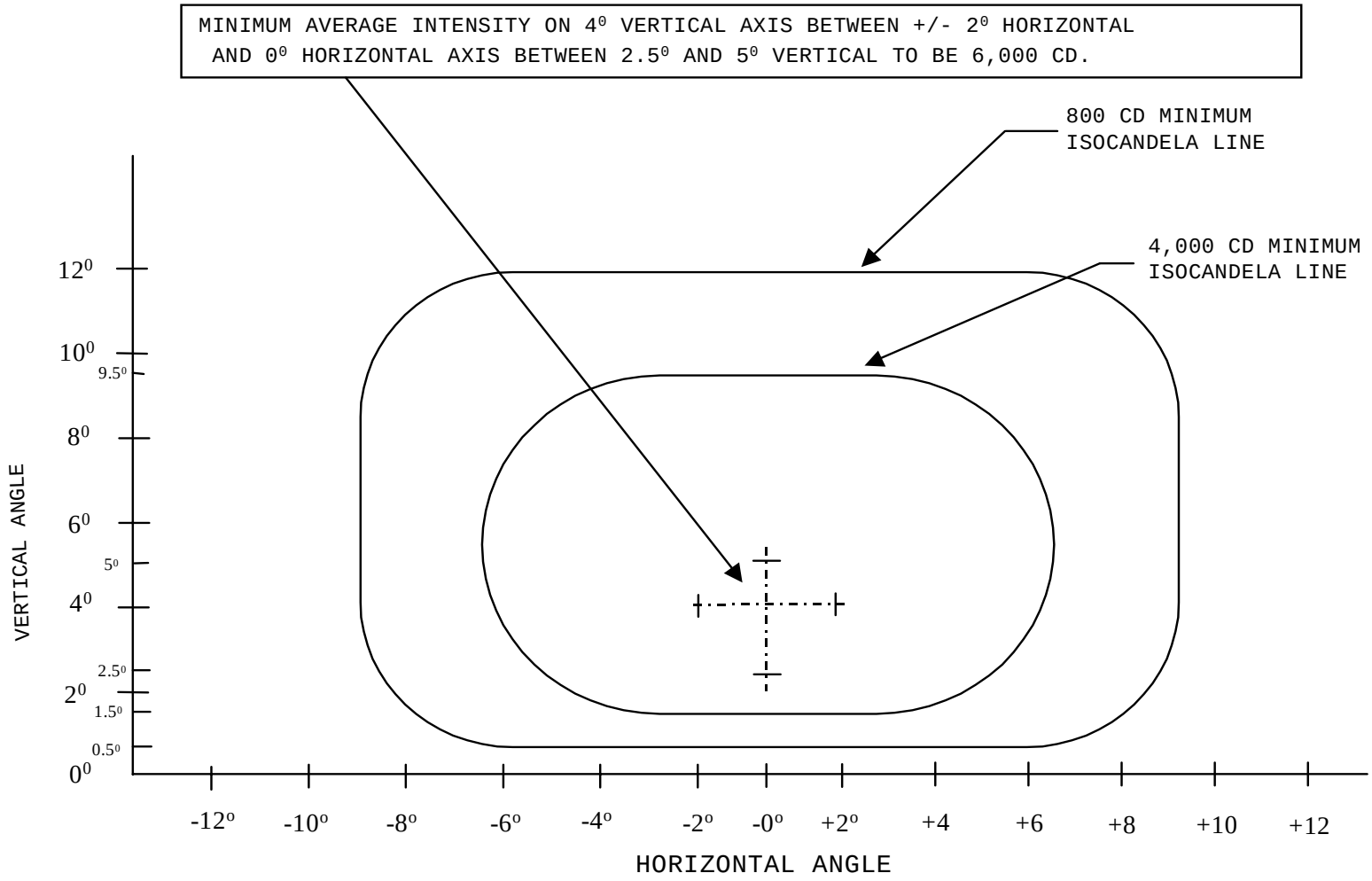

Figure 3. SEMI-FLUSH APPROACH LIGHT - STYLE C (RED)

unit. A slight infringement of lesser CD values is permissible, provided not more than 28 square degrees of the specified illuminated area (or light pattern) is affected with light intensity not less than 3,400 CD.

3.5.5 Thermal shock.- The top surface of the light unit, including the light windows, shall withstand thermal shock imposed by a spray test when the light unit is operating at its maximum operating temperature.

3.5.6 Structural integrity.- The semi-flush light units shall withstand the mechanical stresses described below without damage or deterioration of performance:

3.5.6.1 Vibration.- The light unit shall withstand sinusoidal vibrations at frequencies ranging from 10 to 2,000 hertz (Hz) in the transverse, longitudinal and vertical directions.

3.5.6.2 Static load.- The light unit shall withstand a static load (in pounds) of 500 times the top area of the light unit (in square inches) distributed uniformly over the top surface of the light unit.

3.5.6.3 Dynamic load.- The light unit shall withstand the impact and vibration loads imposed by service vehicles with and without snow chains (snow plows, snow blowers and wire brush sweeping equipment) and aircraft during their operational phases (taxiing, taking off, landing, stopping and turning on the light unit).

3.5.6.4 Shear load.- The light unit shall withstand a shear load of 6,000 pounds applied to the top of the light unit in any direction parallel to the mounting surface.

3.5.6.5 Torque load.- The light unit shall withstand a torque load of 8,333 foot-pounds applied to the top surface of the light unit in any direction parallel to the mounting surface.

3.5.6.6 Hydraulic impact.- The light unit shall withstand hydraulic pressures created by aircraft tires moving at high speeds during operations in wet weather. The top of the light unit shall withstand a momentary hydraulic pressure of 250 psi.

3.5.6.7 Mechanical impact.- The light unit shall withstand the repeated impact of a steel ball with 30 pound-feet (40 J) of energy.

3.5.6.8 Light window load.- The light window shall support a load of 500 psi over the area of the opening when applied directly to the window surface.

3.5.7 Heat dissipation.- Temperature inside and outside of the light unit shall be held to the minimum by utilizing efficient heat dissipation techniques and materials with high coefficients of heat transfer. The maximum allowable external top surface temperature after four (4) hours of operation at maximum rated current is 302^0F (150^0C). The maximum allowable external top surface temperature with the tire of a heavy ground vehicle resting on the light unit is 320^0F (160^0C).

3.5.8 Nameplate.- A nameplate conforming to FAA-G-2100, paragraph 3.3.3, shall be attached to the bottom cover with four type 18-8 stainless steel rivets or screws. The FAA type and serial numbers will be provided by the Contracting Officer.

3.5.9 Certification documents.- Prior to testing the production model, certification shall be furnished to the Contracting Officer that the materials required or allowed as specified by paragraphs 3.4.1.1, 3.4.2, 3.4.3, 3.4.4 3.4.5 and 3.4.6 meet the requirements of these paragraphs.

3.6 Documentation to be furnished.

3.6.1 Instruction Book.- An instruction book shall be provided with each light unit in accordance with FAA-D-2494. A copy of the instruction book shall be supplied in software in a word processing language and media approved by the Contracting Officer.

3.6.2 Technical description.- A description of commercial parts (lamps, fittings, lenses, filters, gaskets, O-rings, etc.) shall be furnished to the Contracting Officer to permit procurement from sources independent of the contractor. The description shall contain all relevant technical details including, but not be limited to, physical, electrical, mechanical, photometric and chromatic characteristics.

4. QUALITY ASSURANCE PROVISIONS.

4.1 General.- The production model light unit shall be energized and operated at maximum rated current during the conduct of the tests described in paragraph 4.3. It may also be necessary to install the light unit in an L-868 light base during the conduct of the tests. Failure of the production model light unit to pass the tests described in paragraph 4.3 shall be cause for rejection.

The contractor shall provide and maintain a quality control program that fulfills the requirements of American National Standards ANSI/ASQC-Q9003. ISO certification is not required. Unless otherwise stated in this specification or in the contract, all tests and inspections to determine compliance with the requirements shall be made by the contractor and shall be subject to Government inspection. The term “Government inspection” as used in this specification, means that an FAA representative will witness the contractor’s testing and inspection, and will carry out such visual and other inspection as deemed necessary to assure compliance with contract requirements. The Government reserves the right to waive Government inspection at the contractor’s plant. When Government inspection is waived, the contractor shall furnish to the Contracting Officer two copies of test data, certified by an independent testing agency, describing the results obtained during the inspection and tests required by the contract and specifications. The test data must demonstrate that the equipment meets contract requirements, and shall include the statement: “This certifies that this unit fully meets all technical requirements of the contract”. The statement shall be dated and signed by a responsible official of the contractor or the testing agency. Shipment shall not be made until the contractor receives written Government approval of the certified test data. Inspecting and testing for the production model and production units shall be conducted by the contractor using test procedures prepared in accordance with ANSI/ASQC-Q9003 and approved by the Government. The contractor shall prepare the test procedures. The Government will require 45 calendar days after receipt of the test procedure for approval.

4.2 Test classification.- Testing shall be accomplished in two categories as follows: (a) production model, and (b) production units.

4.2.1 Production *model*.- The first unit of production, referred to herein as the "production model" shall successfully complete all tests specified in paragraphs 4.3.1 through 4.3.18.

4.2.2 Production *units*.- Upon successful completion of all tests on the production model, the Government will witness testing on the production units. Production units shall undergo the tests specified in paragraphs 4.3.1 Visual inspection, 4.3.2.1.2 Production *unit* tests and 4.3.8 Leakage test.

4.3 Tests.

4.3.1 Visual inspection.- The light units shall be visually inspected for workmanship, fabrication and finish.

4.3.2 Photometric and chromaticity tests.

4.3.2.1 Photometric testing.- Photometric tests shall follow the shock and hydraulic impact tests to determine if the lamp filament has sustained any damage. Photometric tests shall be conducted at maximum rated current with filters in place to demonstrate compliance with paragraphs 3.5.4.1, 3.5.4.2 and 3.5.4.3. The center of the light beam may be shifted ±0.5 degree vertically, and ±1.0 degree horizontally, to meet the photometric curve. Before testing, photometric test equipment shall be calibrated in accordance with paragraph 6 of IES LM-35. The photometric axes are established in relation to a properly installed light unit. The horizontal axis passes through the center of the fixture at grade and is parallel to the runway centerline, and the vertical axis runs through the center of the fixture and is perpendicular to the ground plane. The light unit shall be operated for at least 15 minutes before taking measurements. Photometric measurements shall be taken with at least five random production-run lamps. The method of measurement required to demonstrate compliance with the specification is given below.

4.3.2.1.1 Production *model* tests.- Photometric tests shall be conducted after load tests (paragraph 4.3.3), impact tests (paragraph 4.3.4) and snowplow tests (paragraph 4.3.11) to determine the ability of the semi-flush approach light unit to comply with requirements when subjected to these tests. The tests shall be conducted after ALL load tests of paragraph 4.3.3, not after EACH load test.

The Style A (white) light units shall be tested at 17 positions as follows:
a.) On beam vertical axis at 2^0, 4.5^0, 7^0, 9.5^0 and 12^0 above grade.
b.) At +/- 7.5^0 horizontally from the beam vertical axis, at 2^0, 4.5^0, 7^0, 9.5^0 and 12^0 above grade.
c.) At +/- 15^0 horizontally from the beam vertical axis, at 7^0 above grade.

The Style B (green) and Style C (red) light units shall each be tested at 17 positions as follows:
a.) On beam vertical axis at 1.5^0, 3.5^0, 5.5^0, 7.5^0 and 9.5^0 above grade.
b.) At +/- 3.25^0 horizontally from the beam vertical axis, at 1.5^0, 3.5^0, 5.5^0, 7.5^0 and 9.5^0 above grade.
c.) At +/- 6.5^0 horizontally from the beam vertical axis, at 5.5^0 above grade.

4.3.2.1.2 Production *unit* tests.- The Style A (white) light units shall be tested at 5 positions as follows:
a.) On beam vertical axis at 2^0, 7^0 and 12^0 above grade.
b.) At +/- 15^0 horizontally from the beam vertical axis, at 7^0 above grade.

The Style B (green) and Style C (red) light units shall be tested at 5 positions as follows:
a.) On beam vertical axis at 1.5^0, 5.5^0 and 9.5^0 above grade.
b.) At +/- 6.5^0 horizontally from the beam vertical axis, at 5.5^0 above grade.

4.3.2.2 Chromaticity tests.- Chromaticity tests shall be conducted on the production model (at maximum rated current) after load tests (paragraph 4.3.3), impact tests (paragraph 4.3.4) and snowplow tests (paragraph 4.3.11) to demonstrate the ability of the semi-flush approach light unit to comply with chromaticity requirements The light unit shall meet the chromaticity requirements of SAE-AS-25050A when tested at the center of the main beam and the extremes of the horizontal and vertical beam distribution. Chromaticity outside of distribution boundaries may be verified visually. The tests shall be conducted after ALL load tests of paragraph 4.3.3, not after EACH load test.

4.3.3 Load tests.- The light unit shall withstand load tests of paragraphs 4.3.3.1 through 4.3.3.3 without damage (see also paragraph 4.3.3.4). There shall be no evidence of failure of the lens or its seal, of cracking or breaking of any component which would cause leaks, and there shall be no permanent distortion to cause shifting of the light output. Mounting and support of the light unit during all load tests shall be consistent with the conditions of field installation. The load tests may be conducted on more than one light unit to accelerate the overall test program.

4.3.3.1 Static load test.- The static load shall be applied vertically in a manner to distribute the load uniformly over the light unit spanning the light base. The load shall be applied upon the upper surface and within the inner edge of the light base flange. The load shall be applied to the surface of the light unit through a rubber pad having a Shore A hardness of 55 to 70, of 1 inch thickness and 1 inch less than the diameter of the unit. The load shall be applied uniformly over the rubber at a rate not greater than 10,000 pounds (4,536 kg) per minute. The full load shall be applied for at least 1 minute. The full load shall be applied for 10 repetitions at the stated rate.

A stress analysis shall be prepared, using a Finite Element Model Report on not less than 1,425,636 points or elements. Also, a stress strain curve for the metal of which the load carrying parts of the optical assembly are to be made - with the maximum allowable stress at the elastic limit identified and one half that maximum calculated and identified as the maximum allowable working stress. The light unit shall be designed so that the stress analysis indicates that no element of the optical assembly is stressed above the maximum allowable working stress when the unit is subjected to the full load.

4.3.3.2 Shear load test.- The shear load test shall be conducted in a manner to distribute a load of 6,000 pounds uniformly over an area bounded horizontally by the diameter of the light unit and vertically by the portion of the light unit projecting above the top elevation of the light base flange. The load shall be applied at a rate not greater than 10,000 pounds per minute. The full load shall be applied for at least 1 minute. The full load shall be applied for 10 repetitions at the stated rate.

4.3.3.3 Torque load test.- To demonstrate compliance with paragraph 3.5.6.5, the torque load test shall be conducted by application of a vertical load of 250 psi simultaneously with application of a torque load of 8,333 foot-pounds. The torque shall be applied in the horizontal plane (i.e. the plane of the runway). The vertical load shall be held at the specified value during torque loading and unloading. The loads shall be applied in a manner to distribute the loads uniformly over the light unit. The load shall be applied at a rate not greater than 10,000 pounds per minute. The full load shall be applied for at least 1 minute. The full load shall be applied for 10 repetitions at the stated rate.

4.3.3.4 Alternative load tests.- The contractor, with written permission of the Contracting Officer, may conduct the following tests in place of the tests in paragraphs 4.3.3.1 through 4.3.3.3:

(a) Distributed load test.- The light unit shall be mounted in a test machine on a supporting ring equivalent to the light base flange. A compressive load shall be applied to the entire top surface of the light unit through a rubber pad having a Shore A hardness of 55 to 65. The rubber pad shall have a diameter equal to the diameter of the light unit and a thickness of 1-1/2 inches. No filling material or support shall be used in the light output window cavities. A load of 160,000 pounds shall be applied to the rubber pad through a flat steel plate at least 1 inch thick and a diameter equal to the light unit. The load shall be applied at the rate of 20,000 pounds per minute and held at the computed load for five minutes.

(b) Concentrated load test.- The light unit shall be mounted in a test machine on a supporting ring equivalent to the light base flange. A compressive load shall be applied to the center of the top surface of the light unit through a six inch diameter by 1-1/4 inch thick steel plate. The steel plate will be directly in contact with the light unit. A pad between the steel plate and the light unit will not be permitted. The load shall be applied at the rate of 20,000 pounds per minute to a total of 250,000 pounds. The total load shall be held for five minutes.

4.3.3.5 Alternative test procedures.- For paragraphs 4.3.3.1 through 4.3.3.3 above, the contractor is free to devise and submit, for Government review and written approval, fully engineered and acceptable alternative test procedures to demonstrate the light unit's capability to endure without damage the repetitions of load as described. Any alternative test procedures submitted by a contractor will be disapproved by the Government unless such procedures provide all pertinent technical documentation relevant to the determination of sufficiency for dealing with the fatigue characteristics of the involved load bearing materials. Furthermore, such alternative test procedures shall take into account the fatigue characteristics of the weakest of the particular alloys used in the load bearing parts of the light unit.

4.3.4 Impact test.- The light unit shall be mounted rigidly on either a 1-inch thick steel plate or a 4-inch or more thick concrete base. The dimensions of the steel or concrete base shall be at least 3x3 feet. The unit shall be turned on at maximum rated current for at least 2 hours prior to starting the test. With the unit still on at maximum rated current, a case hardened steel ball weighing 5 pounds shall be dropped 10 times on the top of the light unit from a height of 6 feet, with a 5-minute interval between each drop. Upon conclusion, the light unit shall be opened to determine if the light unit has been damaged or any component displaced. Any evidence of damage inclusive of lamp and filament shall be cause for rejection.

4.3.5 Window loading test.- The light output windows shall be subjected to a uniformly distributed load of 500 pounds per square inch over the area of the exposed window openings. Either a static load or a hydrostatic pressure test may be used. The static load, if used, shall be applied through a one-inch thick rubber pad having a Shore A hardness of 55 to 65. The contour of the rubber block shall be similar to, but not larger than, the exposed glass windows. The test load shall be applied to the rubber pad and windows through a steel plate one-inch thick with a shape similar to but not larger than the rubber pad. The load shall be applied perpendicular to the exposed window faces at the rate of 1,000 pounds per minute and the total load maintained for not less than two minutes. The hydrostatic pressure test, if used, shall require a compartment to enclose the windows and a portion of the top of the light unit. The compartment shall be attached to the top surface of the light unit in a manner to prevent leaking. The compartment shall have sufficient height to contain not less than one inch depth of the test fluid above any enclosed part of the light unit. The test pressure shall be applied at a rate

not to exceed 200 pounds per square inch per minute and the total pressure shall be maintained for not less than two minutes. The windows shall not crack or be permanently displaced or damaged by the test.

4.3.6 Thermal shock.- The light unit shall be installed as specified in paragraph 4.3.4 and operated at maximum rated current until the temperatures have stabilized. At least three gallons of water at a temperature of from 32^0F (0^0C) to 41^0F ($+5^0$C) shall be sprayed on the top surface at a rate to simulate a rainfall of 4 inches per hour. There shall be no evidence of cracking of glass or metal.

4.3.7 Temperature tests.

4.3.7.1 High and low temperature tests.- The light unit shall be subjected to the temperature extremes required in paragraph 3.3.1 in accordance with MIL-STD-810, Method 501.4, Procedure II (High Temperature), and Method 502.4, Procedure II (Low Temperature). Any evidence of malfunction or damage shall be cause for rejection. The light unit shall continue to operate without degradation of performance.

4.3.7.2 Heat dissipation test.- The light unit shall be operated at maximum rated current for at least 4 hours in still air whose ambient temperature is at least 77°F (25°C). Temperature readings shall be taken to assure that the maximum surface temperature does not exceed 302°F (150°C). The light shall then be covered with the tire of a heavy ground vehicle of at least 6,000 pounds GVW rating for a period of 10 minutes. A thermocouple shall be located between the hottest point of the light unit and the tire to register the test temperature. Temperature readings shall then be taken to assure the maximum surface temperature does not exceed 320°F (160°C).

4.3.8 Leakage test.- This test shall be performed after the assembled light unit has successfully passed the vibration test, impact test, window loading test, and load test. Prior to performing this test, the wire leads shall be subjected to a 44-pound tension for 5 minutes to test the integrity of the seal where the leads enter the light unit. The entire light unit shall then be submerged in water at least 3 inches below the surface, subjected to an internal air pressure of 20 psi and maintained for a period of 10 minutes. Any leakage shall be cause for rejection. Leakage tests on production units may use this method, a gas leak detector, or other approved method to ensure that the light unit is watertight. The production model shall also be tested for cool down resistance to ingesting water. The light shall be operated at maximum rated current for 2 hours, turned off, and submerged in room temperature water at least three inches below the surface for at least 10 minutes.

4.3.9 Corrosive fog tests.- To demonstrate compliance with paragraph 3.3.4, tests shall be conducted on scratched samples. Each sample light unit shall have at least three scratches. Each scratch shall be at least one inch long and at least 0.001 inch wide and 0.001 inch deep. Deterioration (rust, pitting, or corrosion, etc.) of any part which prevents the light unit from meeting structural, photometric and leakage requirements shall be cause for rejection.

4.3.9.1 Salt fog test.- A salt fog test shall be conducted in accordance with Method 509.4, Procedure I of MIL-STD-810. The scratched light unit shall be exposed to salt spray for period of at least 72 hours, followed by a drying period of at least 48 hours. This sequence shall be repeated three times. At the conclusion of the test, salt build-up may be removed with tap water.

4.3.9.2 Potassium acetate fog test.- A potassium acetate fog test shall be conducted in accordance with Method 509.4, Procedure I of MIL-STD-810. The potassium acetate solution shall be either 25 percent potassium acetate and 75 percent water, or a solution with proportions recommended by the potassium acetate manufacturer, if different from the 25/75 solution. The scratched light unit shall be exposed to potassium acetate spray for period of at least 72 hours, followed by a drying period of at least 48 hours. This sequence shall be repeated three times. At the conclusion of the test, potassium acetate build-up may be removed with tap water.

4.3.10 Vibration test.- The light unit, complete with all parts and lamp(s), shall be mounted securely on the test machine in a manner to simulate installed conditions.

4.3.10.1 Vibration planes.- The test assembly shall be vibrated in three planes, or directions, as follows:

(a) In a direction perpendicular to the test table (vertically).

(b) Horizontally, parallel to the light beam axis.

(c) Horizontally, at right angles to the light beam axis.

4.3.10.2 Frequencies.- The test assembly shall be vibrated through a frequency range of 10 to 2,000 Hz, in each plane, until the accelerations shown in Table I are reached.

TABLE I

Acceleration in G's	Frequency Hz
0.020 inch D.A. (double amplitude)	10-70
5	70-200
10	200-500
15	500-2000

Duration of each sweep shall be ten minutes. Electrical continuity through the lamp(s) shall be continuously monitored. If the filament and/ or lamp envelope fails at any point in the range of frequencies, the test shall be continued and completed on the light unit alone. Then a new lamp shall be installed and the light unit shall again be vibrated in three planes through the frequencies of 55 to 2,000 cycles at 3 G's. Failure of meeting these requirements shall be a cause for rejection of the light unit and/or of the lamp mounting method.

After the vibration test, the light unit shall be thoroughly examined for mechanical failure of any component, loosening of any part, cracked or broken seals, continuity of electrical circuits, and possible damage to the lamp filaments, supports, etc.

4.3.11 Snowplow test.- The light unit for this test shall be mounted in a light base installed in pavement and traversed at 35 mph, using an Oshkosh P Series or H Series plow vehicle, or equivalent, equipped with a Wausau BMP 2250 (HW) steel edged blade, or equivalent, with its blade set to a clearance of not more than 1/4 inch above the pavement. The vehicle shall be equipped with snow chains. During this test the blade shall pass over the light unit five (5) times, i.e. from 0^0 (towards center of light windows), 45^0, 90^0, 135^0 and 180^0. In three (3) of these passes, the tires and snow chains shall also pass over the light unit. There shall be no damage which would render the light unit unfit for service.

4.3.12 Sand and dust.- A sand and dust test shall be conducted in accordance with Method 510.4, Procedure I and Procedure II of MIL-STD-810 to demonstrate compliance with paragraph 3.3.3. The air velocities used in the sand and dust test shall be 5,700 ft/min and 1,750 ft/min, respectively. The test duration

shall be 6 hours, and the equipment shall be rotated twice during the conduct of the test. Deterioration of any part or infiltration of sand or dust shall be cause for rejection. This test is not required to be imposed on the light window/lens, and therefore appropriate masking may be applied to the window/lens surface during the test.

4.3.13 Chemical immersion tests.- The top of the production model light unit shall be covered with deicing fluid at 194^{0}F (90^{0}C) temperature and a pressure of 250 pounds per square inch shall be applied to the top of the unit for a period of (72) seventy two hours. The light unit shall be operated at 2 hours at maximum rated current before the test and shall be operational at the maximum rated current during the test. After the immersion period, the unit shall be removed from the chemical bath and disassembled for inspection. There shall be no evidence of corrosion, electrical degradation, or leakage into the light unit. The deicing fluid shall be of the potassium acetate type - Cyrotech E36® LRD (Liquid Runway Deicer), Safeway® KA Runway Deicing Fluid, or equal. Concentration of the test fluid shall conform to the industry practice for application of deicing fluids and shall therefore be 50 percent potassium acetate and 50 percent water, by weight.

4.3.14 Low pressure/altitude test.– A low pressure/altitude test shall be conducted in accordance with Method 500.4, Procedure II of MIL-STD-810 from sea level to 10,000 feet mean sea level to demonstrate compliance with paragraph 3.3.2. The light unit shall be operated at 2 hours at maximum rated current before the test and shall be operational at the maximum rated current during the test.

4.3.15 Humidity test.- A humidity test shall be conducted in accordance with Method 507.4, Procedure I of MIL-STD-810 to demonstrate compliance with paragraph 3.3.5, except that a total of three complete 24 hour cycles (72 hours) shall be required (Table 507.2-I (cycle 5)). The maximum temperature shall be 131°F (+55°C) and the highest relative humidity shall be 95 percent instead of 75 percent.

4.3.16 Rain test – A rain test shall be conducted in accordance with Procedure I, Method 506.4 of MIL-STD-810. The wind velocity shall be 40 miles per hour (mph), and the rainfall rate shall be 4 inches per hour. The light unit temperature shall be at least 18^{0}F (10^{0}C) higher than the rain temperature at the beginning of each 30 minute exposure period.

4.3.17 Lamp replacement test.- A failure of the lamp(s) shall be simulated in a light unit which is mounted in a light base installed in the pavement. Using the tools and processes described in the contractor-provided instruction book, a contractor-provided technician will remove the light unit, which is at room temperature, replace the lamp(s) and return the light to service. The total time to accomplish this task shall not exceed the maximum time stated in paragraph 3.5.1.

4.3.18 Accelerated life test.- The light unit shall be set in an L-868 light base installed in sand, simulating its installation in airport pavement, at a stabilized temperature of at least 131°F (+55°C). The sand shall be at least 5 inches thick around the sides and bottom of the light base. The unit shall be operated for at least one-half the rated lamp life at the maximum rated current. After this, the photometric performance of the unit shall be measured as described in paragraph 3.5.4.1,or 3.5.4.2, or 3.5.4.3, as appropriate. Intensities shall not be less than 80 percent of the intensities specified. After this test, the light unit shall be taken apart and thoroughly examined. Any deforming, blistering, heat damage or corrosion shall be cause for rejection.

5. PREPARATION FOR DELIVERY.

5.1 General.- Unless otherwise specified in the contract, each light unit shall be prepared for domestic shipment and extended storage in accordance with paragraphs 5.2 through 5.4.

5.2 Packaging.- Packaging shall be in accordance with ASTM D 3951 and testing shall be in accordance with ASTM D 4169, Assurance Level II, Distribution Cycle 18. Each light unit shall be packaged in an individual unit container. Packaging and shipping containers shall be capable of multiple handlings and storage cycles 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 with maximum outside dimensions of forty seven and one-half (47-1/2) inches by forty (40) inches. Overall height of the pallet and contents shall not exceed forty seven (47) inches. Fork entry of the pallet shall be on the long sides of the pallet. No portion of the load shall overhang or extend beyond the pallet edges. Shrink wrapping to secure intermediate containers is encouraged.

5.4 Marking.- Unit and intermediate packages and exterior shipping containers shall be marked in accordance with FED-STD-123. Each package and/or shipping container shall be marked with bar codes in accordance with FED-STD-123. Each intermediate package and each shipping container shall be durably and legibly marked with the following information: (example in parentheses)

National Stock Number:

Manufacturer’s Part Number:

Item Description: (Approach Light, Semi-flush, Type I, Style A)

Specification Number: (FAA-E-2952)

FAA Type Number:

Serial Number:

Quantity and Unit of Issue:

Contract Number:

Date Packed:

Manufacturer’s Name and Trade Mark:

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