AC 150/5345-28C
3c

CHANGE 1

DATE 1/4/82

ADVISORY CIRCULAR

CHANGE

DEPARTMENT OF TRANSPORTATION
Federal Aviation Administration
Washington, D.C.

Subject: Change 1 to SPECIFICATION FOR L-851 VISUAL APPROACH SLOPE INDICATORS AND ACCESSORIES--Revises Equipment Qualification Procedures

1. PURPOSE. This Change revises the procedures for obtaining equipment qualification approval as contained in paragraph 4.

2. EXPLANATION. Procedures for obtaining equipment qualification approval are now contained in AC 150/5345-1G, Approved Airport Lighting Equipment, and supersede those contained in paragraph 4 of this advisory circular.

3. FILING THIS CHANGE. This Change should be filed on the front of the advisory circular. Page changes to reflect this revision will be made at a later date.

Leonard E. Mudd
LEONARD E. MUDD
Director, Office of Airport Standards

Suggest filing this transmittal at the back of the AC. It will provide a reference authority for changes, a method of determining that all Changes have been received, and a check for determining if the AC contains the proper pages.

Initiated by: AAS-200

file
Reference copy

AC NO: 150/5345-28C

DATE: March 23, 1977

ADVISORY CIRCULAR

SPECIFICATION FOR L-851 VISUAL APPROACH SLOPE INDICATORS AND ACCESSORIES

DEPARTMENT OF TRANSPORTATION

FEDERAL AVIATION ADMINISTRATION

Initiated by: AAP-550

AC NO: 150/5345-28C

DATE: March 23, 1977

ADVISORY CIRCULAR

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

SUBJECT: SPECIFICATION FOR L-851 VISUAL APPROACH SLOPE INDICATORS AND ACCESSORIES.

1. PURPOSE. This advisory circular contains the specifications for visual approach slope indicator (VASI) and simple abbreviated visual approach slope indicator (SAVASI) equipment.

2. CANCELLATION. Advisory Circular (AC) 150/5345-28B, Specification for L-851 Visual Approach Slope Indicators and Accessories, dated February 16, 1972.

3. REFERENCE. Publications that may be used in connection with this advisory circular are listed in the specification.

4. EXPLANATION OF REVISIONS. Major changes in the specifications are as follows:

   a. Addition of transient suppression, lightning protection, and an ammeter in solid-state power and control units.

   b. Widening of the transition bar.

   c. Specifying lamp photometrics in lieu of an exact lamp. This will allow use of voltage or current PAR-64 lamps.

5. HOW TO OBTAIN THIS CIRCULAR. Additional copies of this circular, AC 150/5345-28C, and other advisory circulars that are free of charge may be obtained from the Department of Transportation, Publications Section, TAD-443.1, Washington, D.C. 20590.

Joseph A. Foster

JOSEPH A. FOSTER
Assistant Administrator
Office of Airports Programs

Initiated by: AAP-550

TABLE OF CONTENTS

SPECIFICATION FOR L-851 VISUAL APPROACH SLOPE INDICATORS AND ACCESSORIES

1. SCOPE.

1.1 Scope. This specification covers the requirements for a visual approach slope indicator (VASI) system and a simple abbreviated visual approach slope indicator (SAVASI) system. The system consists of either two (SAVASI or VASI-2), four (VASI-4), or six (VASI-6) lamp housing assemblies, a power and control assembly, and an aiming instrument set. The SAVASI lamp housing has a single lamp while the VASI has three lamps.

2. APPLICABLE PUBLICATIONS.

2.1 FAA Documents. The following publications of the issue in effect on the date of application for qualification form a part of this specification and are applicable to the extent specified herein.

2.1.1 FAA Specifications.

FAA-G-2100/1b Electronic Equipment, General Requirements, Part 1 Basic Requirements for all Equipment

FAA-G-2100/1b Amendment 2, Electronic Equipment, General Requirements

FAA-G-2100 Supplement 4, Electronic Equipment, General Requirements

2.1.2 FAA Standards.

FAA-STD-013a Quality Control Program Requirements

2.1.3 FAA Drawings.

B-4904 Frangible Coupling, Type 1 and 1A, Details

2.1.4 FAA Advisory Circulars.

AC 150/5345-1 Approved Airport Lighting Equipment

2.2 Federal Publications. The following publications of the issue in effect on the date of application for qualification form a part of this specification and are applicable to the extent specified herein.

2.2.1 Federal Specifications.

QQ-A-200/8 & 9 Aluminum Alloy Bar, Rod, Shapes, Tube and Wire, Extruded

QQ-A-250	Aluminum Alloy Plate and Sheet, General Specification fo
QQ-B-626	Brass, Rod, Bar and Strip
TT-E-489	Enamel, Alkyd, Gloss
L-P-383	Plastic Material, Polyester Resin, Glass Fiber Base, Low Pressure Laminated
QQ-A-591	Aluminum Alloy Die Castings
QQ-A-601	Aluminum Alloy Sand Castings
TT-E-527	Enamel, Alkyd, Lusterless
TT-P-1757	Primer Coating, Zinc Chromate, Low-Moisture-Sensitivity

2.2.2 Military Specifications.

MIL-C-5541	Chemical Conversion Coatings on Aluminum and Aluminum Alloys
MIL-R-7575	Resin, Polyester, Low Pressure Laminating
MIL-S-7720	Steel, Corrosion Resistant
MIL-A-8625	Anodic Coating, for Aluminum and Aluminum Alloys
MIL-C-9084	Cloth, Glass, Finished, for Resin Laminates
MIL-M-15617	Mats, Fibrous-Glass, for Reinforced Plastics
MIL-C-22750	Coating, Epoxy Polyamide
MIL-C-25050	Colors, Aeronautical Lights and Lighting Equipment General Requirements for

2.2.3 Federal Standards.

FED-STD-595	Colors

2.2.4 Military Standards.

MIL-STD-810B	Environmental Testing Methods
MIL-STD-462	Electromagnetic Interference Characteristics, Measurements of
MIL-STD-889A	Dissimilar Metals

2.2.5 National Bureau of Standards.

NBSIR-74/603	Standard Procedure for Setting Photoelectric Controls

2.3 Other Publications. The following publications of the issue in effect on the date of application for qualification form a part of this specification and are applicable to the extent specified herein.

2.3.1 National Electrical Manufacturers Association (NEMA) Standards.

SG-5 Standards for Power Switchgear Assemblies

2.3.2 National Board of Fire Underwriters Standard.

NFPA No. 70 National Electrical Code

(Copies of FAA specifications and standards may be obtained from the Federal Aviation Administration, 800 Independence Ave., S.W., Washington, D.C. 20591, Attn: AAF-110. Requests should fully identify material desired; i.e., specification or standard, number, and date.)

(Information on obtaining Federal specifications and standards may be obtained from General Services Administration offices in Washington, D.C., Atlanta, Boston, Denver, Chicago, Kansas City, New York, San Francisco and Seattle.)

(Copies of the referenced military specifications may be obtained from the Commanding Officer, Naval Supply Depot, 5801 Tabor Avenue, Philadelphia, Pennsylvania 19120, Attn: Code CDS.)

(Single copies of National Bureau of Standards publications may be obtained from the Department of Commerce, Washington, D.C. 20234.)

(Information on obtaining NEMA standards may be obtained from the National Electrical Manufacturers Association, 155 East 44th Street, New York, New York 10017.)

(Information on obtaining the National Electrical Code may be obtained from the National Board of Fire Underwriters, 85 John Street, New York, New York 10038.)

(Copies of FAA drawings may be obtained from the Federal Aviation Administration, 800 Independence Ave., S.W., Washington, D.C., 20591, Attn: AAF-510.)

3. REQUIREMENTS.

3.1 Components to be Supplied for Each System.

3.1.1 SAVASI.

(a) Two SAVASI lamp housings complete with lamp and mounting hardware in accordance with paragraph 3.4.

(b) One tilt switch assembly per lamp housing in accordance with paragraph 3.4.15.

(c) One aiming instrument set complete with level, aiming bar, calibration bar, and storage case in accordance with paragraph 3.5.

(d) A power and control unit in accordance with paragraph 3.6.

(e) Two instruction books in accordance with paragraph 3.12.

3.1.2 VASI-2.

(a) Two lamp housing assemblies complete with lamps and mounting hardware in accordance with paragraph 3.4.

(b) One tilt switch assembly per lamp housing in accordance with paragraph 3.4.15.

(c) One aiming instrument set complete with level, aiming bar, calibration bar, and storage case in accordance with paragraph 3.5.

(d) A power and control assembly in accordance with paragraph 3.6.

(e) Two instruction books in accordance with paragraph 3.12.

3.1.3 VASI-4.

(a) Four lamp housing assemblies complete with lamps and mounting hardware in accordance with paragraph 3.4.

(b) One aiming instrument set complete with level, aiming bar, calibration bar, and storage case in accordance with paragraph 3.5.

(c) One power and control assembly including all components in accordance with paragraph 3.6.

(d) Two instruction books in accordance with paragraph 3.12.

3.1.4 VASI-6.

(a) Six lamp housing assemblies complete with lamps and mounting hardware in accordance with paragraph 3.4.

(b) One aiming instrument set complete with level, aiming bar, calibration bar, and storage case in accordance with paragraph 3.5.

(c) One power and control assembly including all components in accordance with paragraph 3.6.

(d) Two instruction books in accordance with paragraph 3.12.

3.2 General Functional Requirements. The equipment specified herein is a precision optical assembly and with its control circuitry is to be used at airports to provide accurate visual glide path information to landing aircraft. The equipment consists of the lamp housing assembly (3.4), the aiming instrument set (3.5), and the power and control assembly (3.6).

3.3 Environmental Requirements. The equipment shall be designed for outdoor installation and continuous operation, and shall meet all specification requirements while operating under the following environmental conditions.

3.3.1 Temperature. A temperature range from -43°C to +55°C.

3.3.2 Altitude. Any altitude from sea level to 10,000 feet (3050 m) above sea level.

3.3.3 Humidity. A humidity range from 10% to 95% at +55°C ambient temperature.

3.3.4 Sand and Dust. Exposure to airborne sand particles encountered on deserts or the result of air blast from jet aircraft.

3.3.5 Salt Spray. Exposure to a salt-laden atmosphere.

3.4 Lamp Housing.

3.4.1 General. The SAVASI lamp housing contains one lamp while the VASI-2, 4, or 6 housing contains three lamps. The lamp housing is an optical bench consisting of (1) a lamp bulkhead for mounting one or three PAR-64 lamps, as appropriate, of not more than 200 watts each, (2) a lens bulkhead for mounting one or three filter-lens assemblies, (3) a transition bar, (4) a vertical cutoff bar, and (5) a horizontal aperture, all in an aluminum or reinforced fiber glass housing shell. A centerline marking or projection shall be placed on the top of the housing at front and rear to facilitate field alignment. The lamp housing shall also be provided with a grounding lug, cable clamp, terminal block, and means for transverse leveling and adjusting the vertical angle of the optical centerline.

The housing shall be designed to maintain the desired light beam orientation under the environmental conditions specified in paragraph 3.3 and shall hold its shape during normal shipment, installation, and maintenance operations. The design shall prohibit birds or rodents from entering the rear portion of the lamp housing.

3.4.2 Optical Bench. The optical bench shall be constructed of aluminum and shall be directly connected to the mounting legs. The aluminum shall be as specified in paragraph 3.7.2 and shall be of sufficient thickness to obtain the required rigidity. The dimensions for the optical bench shall be as shown in Figure 2.

3.4.3 Housing Shell. The optical bench shall be enclosed by a housing shell made of either aluminum or fiber glass as specified in paragraph 3.7. If of fiber glass, the housing shall not be constructed as part of the optical bench. Dimensions and shape of the housing shell are optional provided they accommodate all essential components of the optical bench. The housing shell shall cover that portion of the bottom of the optical bench from the rear end to 3 inches (7.5 cm) in front of the lens bulkhead. The remaining portion of the bottom may be either screened in or closed. Adequate drain holes shall be provided in the covered bottom surfaces. Provisions may be made on the rear vertical surface of the shell for mounting the power and control assembly.

3.4.4 Access. A hinged or sliding cover plate shall be provided on the housing to permit access to the lamps, filter lens, and electrical components. The access cover plate shall have a positive latch to permit securing in the closed position. The latch shall be easily opened and secured with a gloved hand.

3.4.5 Bulkheads. Bulkheads shall be provided at the locations shown on Figure 2 for mounting the lamps and filter lens. The bulkheads may be of the removable type if required to facilitate replacement of lamps and filter lens. If of the removable type, quick-disconnect hardware shall be used that permits easy removal without the use of tools. The bulkheads and retaining hardware for the lamps and filter lens shall insure no movement which could affect the optical performance.

3.4.5.1 Lamp Mounting. The lamp bulkhead shall be designed to provide for the lamps being mounted in such a manner as to provide positive positioning of the lamp seating lugs against the lamp seating plane. The PAR-64 lamps are to be held firmly in place by a lamp mounting system to maintain proper seating of the lamps yet allow lamps to be easily replaced by one person. The vertical plane formed by the lamp seating lugs shall be perpendicular to the lamp housing optical centerline.

3.4.5.2 Filter-Lens Assembly. Filter-lens assemblies shall be supplied for each lamp in a lamp housing. They shall consist of an aviation red (per MIL-C-25050) filter (or filter lens if required) at the top and clear glass (or lens if required) at the bottom. The filter (lens) assemblies and retaining hardware shall be positively keyed to assure correct mounting in relation to the lens bulkhead. The filter (lens) assemblies shall be easily removable for replacement purposes.

3.4.6 Aperture. The aperture is an open space typically 2 inches ±1/32 inch (5.08 ±.08 cm) in height and is located, with respect to the lamp and lenses, as shown in Figures 1 and 2. The bottom surface of the aperture shall be parallel with the bottom surface of the transition bar. The width of the aperture shall be sufficient to allow the required horizontal beam spread of the light beam, see figures 3 and 4. The design shall provide for an optional feature to be included, when specified by the purchaser, which will permit reducing the horizontal beam width to at least 12 degrees.

3.4.7 Transition Bar. A transition bar shall be provided for the purposes of aiming the housing and providing proper definition between the red and white signal. The overall height of the transition bar is typically 1 inch (2.54 cm) with a ledge located 1/2 inch (1.27 cm) above the bottom of the transition bar to rest the aiming bar on. The width of this ledge should be sufficient to support the level included in the aiming set for transverse leveling. See Figure 2 for details and tolerances.

3.4.8 Cutoff Bar. A cutoff bar shall be provided as shown in Figure 2 if required to prevent stray light reflections.

3.4.9 Terminal Block. A terminal block shall be provided in the rear of the lamp housing. The terminal block shall be of rugged construction incorporating noncorrosive-type terminals rated to carry 10 amperes at 480 Vac. Electrical contact surfaces or terminals shall be brass, bronze, or copper. Pressure screws of the electrical terminals shall be brass, bronze, or stainless steel. The terminal block shall have sufficient terminals to accommodate all internal connections plus connection of external power cables using conductors ranging in size from #12 AWG to #8 AWG.

3.4.10 Lamp Connectors. Lamp connectors, General Electric #AC1622 or equal quality, shall be provided with each housing for connecting each lamp to the terminal block. The leads shall be #16 AWG minimum, heat resistant (90°C) insulated, stranded copper conductors. Wiring is not to interfere with the removal of lamps, filters, or bulkhead or in making adjustments.

3.4.11 Power Input Cables. Space shall be provided in the rear of the lamp housing to permit the connections of power and interconnecting cables to the terminal block. At least two holes or knockouts shall be provided in the bottom rear of the housing to accommodate at least 1 1/4-inch (3.2 cm) flexible conduit connectors.

3.4.12 Weight. The weight of the lamp housing assembly, excluding lamps and mounting legs, shall be held to a minimum, consistent with the required rigidity, and shall not exceed 100 pounds (45 kg).

3.4.13 Housing Mounting. The SAVASI lamp housing shall be mounted on two to four support legs and the VASI lamp housing shall be mounted on four support legs which shall be adjustable to permit aiming the light beam to any vertical angle from horizontal up to 6 degrees. The legs shall also permit transverse leveling of the unit where either side may be up to 1 inch lower than the other side after installation.

3.4.13.1 Support Legs. The housing support legs shall consist essentially of (1) mounting and adjustment hardware, (2) 2-inch (5 cm) EMT tubing, (3) frangible couplings conforming to FAA Drawing B-4904, and (4) aluminum flanges. The aluminum flanges shall be designed for installation on a concrete pad and shall have a boss threaded to receive the frangible coupling. The adjustment hardware shall be designed so as to prevent any unintentional displacement of the lamp housing due to vibration. The EMT tubing is not furnished under this specification.

3.4.14 Lamp-Out Features. Means shall be provided to compensate for a burned-out series lamp to insure continued operation of the remaining lamps in a lamp housing. If load resistors are used, they shall be located so as to dissipate heat without damaging any components of the light box. Any openings used for needed ventilation shall be screened.

3.4.15 Tilt Switch System. The tilt switch system shall deenergize the lamps in the SAVASI or VASI-2 when the optical pattern of the lamp housing is lowered between 1/4 and 1/2 degree or raised between 1/2 and 1 degree with respect to a preset approach angle. The tilt switch system shall have a time delay of at least 10 seconds that will prevent intermittent circuit activation if the lamp housing vibrates due to external causes. The tilt switch system shall have a fail-safe circuit or device that will insure that any malfunction of the tilt switch assembly, including loss of its input power, will deenergize the lamp circuit. Adequate capacity and voltage rating shall be provided for all current-carrying parts of the tilt switch system or auxiliary power equipment used in conjunction with the tilt switch system.

3.4.15.1 Optional Tilt Switch System. Some users prefer to power the lamp housing assemblies with a constant current regulator (not furnished under this specification) in lieu of the power and control assembly specified in paragraph 3.6. Manufacturers may, at their option, obtain qualification for a tilt switch system to operate with this type of equipment.

3.4.16 Lamp Housing Finish. All exterior and interior aluminum surfaces shall be pretreated with a chemical film in accordance with MIL-C-5541, Class 1A. These surfaces shall be sprayed with one coat of zinc chromate primer in accordance with Federal Specification No. TT-P-1757, composition L, color Y.

3.4.16.1 Interior Finish. Interior surfaces which could cause undesirable reflections shall be painted aviation black, lusterless, color No. 37038 in accordance with FED-STD-595. The paint shall meet the requirements of Federal Specification TT-E-527. Paint used on interior fiber glass surfaces shall be in accordance with MIL-C-22750.

3.4.16.2 Exterior Finish. All exterior surfaces of the lamp housing, except the front and rear of the aperture and the reflection/deflector plate, shall be painted with not less than a body coat and two finish coats of alkyd baking enamel in accordance with Federal Specification TT-E-489, Class B, international orange, color No. 12197, of FED-STD-595. The paint shall be applied to at least a 3-mil thickness, and the final painted surfaces shall be free of blotches, scratches, and runs. The front and rear of the aperture and the reflection/deflector plate, if used, shall meet the requirements of paragraph 3.4.16.1. For fiber glass surfaces, color shall be achieved as specified in paragraph 3.7.3.

3.4.17 Photometrics. The light output from each lamp housing shall meet or exceed the isocandela values of figure 2, or figures 3 and 4 as applicable.

3.5 Aiming Instrument Set.

3.5.1 Aiming Bar. The aiming bar shall be an accurate alignment instrument that can be operated by one person. It shall be constructed of aluminum and shall be a lightweight, rugged instrument designed to permit adjustment of the optical centerline of the lamp housing to the desired vertical angle. The use of timmerman nuts will not be allowed due to their lack of positive control. One end of the aiming bar shall rest on the upper ledge of the transition bar and the other end on the bottom surface of the aperture. Design and construction shall be such that, when the instrument is supported on the two surfaces indicated above, deviation from true position due to its own weight shall not exceed 3 minutes of arc. A dial shall be provided for setting the desired angle and shall indicate from 1.5 to 6 degrees in increments of 0.10 degrees. The spacing between each degree mark shall be at least 1/2 inch (1.3 cm). A zero-degree setting shall be provided on the dial for calibration purposes. Alternate designs, using a vernier dial, may be used where provided with equivalent gradations as specified for the direct reading dial. The bar shall be designed so that repeated changes of the dial setting will not cause excessive wear and deterioration of the instrument's accuracy. Aluminum and other soft metals shall not be used where subject to metal-to-metal rubbing. The aiming bar shall have provisions for firmly securing the dial setting after factory calibration but shall permit field adjustment to the zero-degree position by the user when the need to do so is indicated by checking its accuracy on the calibration bar. The aiming bar shall utilize a 6-inch (15 cm) level having an accuracy of ± 2 minutes.

and shall be L.S. Starrett No. 98 or equivalent. The level shall be permanently mounted on the aiming bar to permit fine adjustments in calibrating the instrument. The level shall have a protective device to minimize possible damage. Operating instructions shall be permanently provided on the bar.

3.5.2 Calibration Bar. A calibration bar shall be provided with each aiming bar to permit field checking and calibration. The calibration bar shall be constructed of aluminum of a shape, size, and thickness to provide a rigid and accurate checking instrument. The calibration bar shall be designed for lying on a flat surface or in the carrying case (3.5.3) and shall have adjustment features to permit its being leveled to a horizontal plane. A level, not attached to the bar, shall be provided with each calibration bar to permit leveling. The level shall be the same type as used on the aiming bar (3.5.1). The calibration bar shall have devices comparable to the transition bar and aperture of the lamp housing so that the aiming bar can be mounted thereon and accurately adjusted to the zero and 3-degree dial settings. Operating instructions shall be permanently provided on the bar.

3.5.3 Carrying and Storage Case. A case shall be provided for carrying and storing the aiming bar, calibration bar, and level. It shall be constructed of a material suitable for the intended use and shall, with all parts inside, be light enough to be easily carried by one person. The case shall have handles for carrying and suitable latches for securing in a closed position. The inside shall be designed to accommodate the instruments so they will be held firmly in position.

3.5.4 Aiming Instrument Set Finish. All aluminum surfaces of the aiming and calibration instruments shall be finished in accordance with MIL-A-8625.

3.6 Power and Control Assembly.

3.6.1 General. The power and control assembly shall form one compact, self-cooled unit and shall have provisions for mounting on frangible supports or on a lamp housing. Units shall be available to power two, four, or six lamp housings. The operation of the power and control assembly shall be possible from a remote location. Detailed description of components and requirements are provided in the subparagraphs of 3.6.4.

3.6.2 Power Input Requirements. The power and control assemblies shall be designed to operate on 240 V. (480 V. optional) for VASI's and 120 V. for SAVASI's. The input power shall connect to the internal circuitry through a circuit breaker (paragraph 3.6.4.2).

3.6.3 Control Cabinet. The control cabinet shall include all power and control components (3.6.4), including terminal blocks and protective devices. The cabinet shall be an outdoor, raintight (within the meaning of NEMA definition SC-5-1.018), aluminum, NEMA type enclosure of sufficient size. Proper high-temperature wire (3.7.6) shall be used throughout the cabinet.

Knockouts are not required; however, the cable entrance provided shall enable a watertight connection to be made. Sufficient wiring space shall be provided in the bottom of the cabinet for all wiring (input, output, and internal) and for all terminal blocks. Access to the interior of the cabinet shall be provided through one hinged and gasketed door equipped with provision for padlocking. The padlock hasp shall have a 7/16 inch (1 cm) hole. The door shall be able to open a minimum of 110 degrees. The internal face portion of the door shall accommodate a moisture resistant wiring diagram with operating instructions for the control unit. An internal ground lug shall be provided in the cabinet for grounding, using a #6 AWG bare, solid copper wire. Electronic components, where used, shall be mounted on printed wiring boards (3.7.8). All adjustments located on printed wiring boards shall be lockable and readily accessible to the operator. Assembly of circuit components shall be made so as to facilitate component replacement without removing the main mounting plate.

3.6.4 Components. The following components shall be provided within the control cabinet.

3.6.4.1 Terminal Blocks. Terminal blocks of the enclosed base type, with screw-pressure terminals for the smaller conductor sizes, shall be provided. The input positions shall be suitable for #4 AWG through #8 AWG standard conductors. Positions, suitable for #8 AWG through #22 AWG standard conductors, shall be provided for connections of 120V accessories. Output positions, suitable for #8 AWG through #22 AWG standard conductors, shall be provided. Each pressure-type terminal shall be equipped with a pressure plate to prevent the tip of the screw turning directly on the wire. Separators are required between the terminals and shall be intergrally molded with the base material. The separators shall be of adequate design to prevent current leakage due to humidity. Marking shall be provided in accordance with paragraph 3.10.3.

3.6.4.2 Circuit Breaker. A 2-pole (single pole for SAVASI), molded-case, thermo-type circuit breaker shall be provided as the main circuit breaker and power switch. The circuit breaker shall have an arc-quenching chamber and shall be capable of 5000 amps RMS interrupting capacity.

3.6.4.3 Solid State Component Requirements. Solid-state phase control devices shall be rated for twice their maximum normal steady load current and at a minimum of 20 times normal for surge protection. They shall have suitable heatsinks to insure operation within the thermal constraints of the particular device selected. The equipment shall withstand, without operational interruption or malfunction and without damage, a transient increase in the input line voltage of 20% of the peak value for as long as 50 milliseconds. They shall not be damaged by the currents or voltage encountered when lamp fails.

3.6.4.4 Photoelectric Switch Device. A light-intensity activated device shall be provided. All operating components, except the photosensing device itself, may be mounted on a printed wiring board mounted within the cabinet. The applicable features shall provide rated lamp current/voltage when the illumination on a vertical surface facing north reaches 50 to 60 footcandles (538 to 646 lux) and shall reduce power output to provide only 10% relative lamp intensity when the illumination falls to 25 to 35 footcandles (269 to 377 lux). A single electrical control shall be provided to adjust the "turn-off" value between 25 and 45 footcandles (269 to 484 lux). A symmetrical time delay of 9 to 30 seconds shall be provided to prevent the output current/voltage from changing due to transient light conditions. A fail-safe feature shall set the output power at the 10% lamp intensity level in the event the photosensing device fails in the open mode.

3.6.4.5 Photosensing Device. The photosensing device shall be mounted above the top surface of the cabinet and shall be able to rotate and lock in position. The device shall be hermetically sealed with a rated output higher than the operational demand. The device shall have a spectral response which peaks in the 5500-6000 angstroms region and shall activate the photoelectric switching device (3.6.4.4). The power supply shall provide the proper voltages and currents necessary to operate the photoelectric switching device within the tolerances and conditions set forth in this specification.

3.6.4.6 Power Control Device. A system device shall be provided to power the lamp housing units with appropriate voltages or currents at the individual lamp housings. Provide one set of variable controls for each output circuit; i.e., one set for each two lamp housings to be connected. These controls shall have sufficient range to provide 35-100% relative lamp intensity for day use and 1-35% for night use, as activated by the photocell. For series circuits, a true RMS indicating ammeter (paragraph 3.6.4.7) shall be furnished with all solid-state units so that field settings of 100% and 10% relative lamp intensity can be made by matching preset marks on the meter. The control device shall limit the RMS value of the output current to no more than 3% above rated lamp current regardless of the output current and voltage wave form, input current and voltage transients, ±10% variation from nominal input voltage, lamp failure, or internal circuit failure. For multiple circuits, provide means in the device to compensate for 5 and 10% voltage drops in the power input lines and 2½, 5, 7½, and 10% losses in the output circuit lines. This will allow field connections to provide 95-100% relative lamp intensity for day use and 10-15% intensity for night use within a 3% voltage variation between lamp housings. All components shall be readily removable with standard tools without disconnecting field wiring. Small electronic components such as transistors, diodes, capacitors, resistors, etc., which are not easily replaceable with standard eletrician's field tools, shall be mounted on removable circuit boards. Devices such as SCR's, thyristors, etc., may be mounted on removable heat sinks. All interconnecting wires shall be terminated in either spade or slip-on terminals.

3.6.4.7 RMS Ammeter. A panel-type iron-vane ammeter shall be provided in constant current power and control units. The ampere rating of the lamp shall be indicated in the upper 60% of the meter scale. The meter shall have at least 2% accuracy. The meter scale shall be not less than 120° with 0.2 ampere divisions. The ammeter shall measure the output current from the power and control assembly. A switch shall be provided to switch the meter to the different output circuits or to an off position.

3.6.5 Transient Suppression. Transient suppression shall be provided per FAA-G-2100/1b, paragraph 1-3.3.4, with all solid state power and control units. In addition, transients caused by lightning, induction, static, switching, electromagnetic interference, etc., shall be suppressed. As a minimum, the transient suppression shall be capable of a 10 x 20 microsecond current surge of 15,000 amperes with the subsequent power-follow current and a voltage surge of 10KV/microsecond minimum.

3.6.6 Repairs. The design of the power and control assembly shall be such that adjustment and repairs can be made in the field with commercially available simple tools. Special tools, if required for servicing, shall be furnished by the manufacturer.

3.6.7 Power and Control Assembly Finish. All aluminum exterior and interior surfaces shall be pretreated with a chemical film per MIL-C-5541, Class 1A. All aluminum exterior surfaces of the control cabinet shall be sprayed with one coat of zinc chromate primer per Federal Specification No. TT-P-1757, composition L, color Y. Following the application of the primer, the exterior surfaces of the control cabinet shall be painted with not less than a body coat and a finish coat of alkyd baking enamel per Federal Specification TT-E-489, Class B, international orange, color No. 12197 of FED-STD-595. The paint shall be applied to at least 3-mil thickness, and the final painted surfaces shall be free of blotches, scratches, and runs.

3.7 Materials. Materials and equipment components shall be as specified herein. Parts or materials not specifically designated shall be suitable for the intended purpose and shall be in accordance with the best industrial standards and practices. All fasteners, other than the screw type, shall be of corrosion-resistant material. Threaded fastener material shall be in accordance with MIL-S-7720 (300 series) or QQ-B-626.

3.7.1 Metals. Metals shall be either inherently corrosion resistant or suitably protected to resist corrosion or oxidation. The use of dissimilar metals shall be in accordance with MIL-STD-889A. Parts to be removed during servicing should be suitably coated to prevent corrosion or seizing.

3.7.2 Aluminum. Aluminum shall be in accordance with Federal Specifications QQ-A-200/8 and 9 and with QQ-A-250. All aluminum surfaces which are not required to be painted shall be anodized after fabrication in accordance with MIL-A-8625.

3.7.3 Fiber Glass. All material used shall meet the following requirements. The resin used in the laminate preparation shall meet the requirements for Grade A, Class O resin in accordance with Military Specification MIL-R-7575. The reinforcing mat shall meet the requirements for type PR fiber glass as set forth in Military Specification MIL-M-15617. Glass reinforcing fabric shall meet the requirements of Military Specification MIL-C-9084. The gelcoat shall consist of polyester resin compounded for spray application. The formulation used shall produce a tightly-adhering, nonbrittle, pit-free, glossy coating on the housing shell. It shall be the manufacturer's responsibility to meet the requirements for formulation and application. Additive fillers shall comply with paragraph 3.3.4 of Federal Specification L-P-383. The adhesive used in fabrication shall be a structural epoxy-type. Formulations containing metallic or carbon powders as bulking agents shall not be used.

3.7.3.1 Fabrication. The manufacturer shall select a fabrication method that will produce a laminate that meets the following requirements. The laminate shall have 35±5% glass by weight. The maximum permissible quantity of fillers used, based on weight percentage of resin, shall be 5% with cloth reinforcing and 30% with mat reinforcing. The interior surface shall be equivalent to a bag-molded surface, with a smooth exterior surface equivalent to that obtained by molding against a polished surface. A dye stabilizer, American Cyanamid Company's "Cyasorb UVG Light Absorber," or equal, shall be incorporated into the gelcoat in accordance with the manufacturer's instructions. A gelcoat of approximately 15 mils in thickness may be applied to obtain the required surface texture. The laminate shall be free of gaps, cracks, holes, blisters, resin pockets, excess surface resin, burning, areas lacking resin, tackiness, delamination, porosity, wrinkling, roughness, and warpage. All such defects may be reworked, except tackiness and serious warpage. Color shall be achieved by thoroughly mixing the pigment into the gelcoat prior to application. Lap widths shall be superimposed upon each other.

3.7.4 Gasket Materials. Materials used for gaskets shall be made of rubber-like compound suitable for the intended purpose, such as for door seal, dust cover gaskets, etc., and shall not include natural rubber or other materials which deteriorate rapidly.

3.7.5 Grommets. Grommets shall meet the requirements of FAA-G-2100/1b, paragraph 1-3.10.8.

3.7.6 Cables and Wires. Cables and wires used for connection of the power and control wiring within the unit shall be as specified under wiring, paragraph 3.10.2, or elsewhere in this specification.

3.7.7 Component Ratings. When component ratings are not specified, they shall be selected to insure that the components are not operated in excess of 80% of their normally derated maximum values for the temperatures encountered under the specified equipment environmental conditions.

3.7.8 Printed Wiring Boards. Printed wiring boards shall conform to industry standards suitable for this application. Use of copper-clad laminates with paper bases is prohibited. Connectors shall conform to the best industry standards.

3.8 Workmanship. The equipment shall be fabricated in accordance with the best industry practice. Welds, seams, corners, and edges shall be carefully constructed to eliminate sharp edges, unsightly protrusions, and when completed, present smooth, accurate bends and corners. All grease, oil, welding flux, and dirt shall be removed prior to painting.

3.9 Nameplates. Provide a nameplate permanently and legibly filled in with at least the following:

3.9.1 Lamp Housing.

Identification: FAA-L-851, VASI or SAVASI, as applicable.

Manufacturer's part number, type, name, or trademark.

3.9.2 Power and Control Unit.

Identification: FAA-L-851, VASI or SAVASI, as applicable.

Input Rating: _____volts, _____amperes, single phase 60 Hz.

Manufacturer's part number, type, name, or trademark.

3.9.3 Aiming Bar.

Identification: FAA-L-851.

Manufacturer's part number, type, name, or trademark.

3.9.4 Calibration Bar.

Identification: FAA-L-851.

Manufacturer's part number, type, name, or trademark.

3.9.5 Instruction Plate. The aiming and calibration bar carrying case shall have an instruction plate installed on the inside of the cover in a location easily viewed by the user and shall contain all necessary instructions for calibration and use of the aiming instrument set.

3.10 Assembly, Wiring, and Marking.

3.10.1 Assembly. Assembly of all parts shall be in a permanent manner with the components accessible for servicing and replacement. All bolts used shall be of sufficient length that at least three full threads will show over the nut after tightening. Internal-tooth lockwashers shall be used on all bolts where good electrical continuity is required for grounding. The chassis shall not be used as a current-carrying part of the electrical circuitry.

3.10.2 Wiring. Connecting wires shall be of copper with proper insulation cover and of adequate AWG size for the intended application in accordance with FAA-G-2100/1b, paragraph 1-3.10.1. Unless otherwise specified, the wires and wiring shall conform to the National Electrical Code for panel-board wiring. Insulated conductors may be closely grouped together, the bundles secured with flame-retardant lacing or wiring clips and properly trained and supported to avoid strain on the connections. Wire bends with short radii will not be permitted. When removing insulation from the wire ends, care shall be taken to avoid nicking or cutting the conductors.

3.10.3 Marking. All circuit components shall be clearly identified by nameplates or bold permanent-type stencils. Identification markings shall agree with designations on the wiring diagram and parts list. All control wires shall be provided with end identification in the form of a plastic band around the wire with identifying markings permanently stamped thereon or with the markings permanently stamped into the wire itself or with color coded wire. All power conductors shall be similarly marked, except that a permanently stamped rigid laminate tag may be attached near the cable ends in lieu of the above. The terminating points for all wires and cables at terminal blocks shall be clearly identified with the circuit and terminal designations shown on the wiring diagram.

3.11 Wiring Diagram. A complete wiring diagram of the electrical circuits shall be mounted on the inner face of the control cabinet (3.6.3). The diagram shall be moisture-resistant or encased in a moisture-resistant material. All leads and terminals shall be identified on the connection diagram. The diagram shall be sufficiently large to be easily read. All circuit components are to be shown and properly identified; no "black boxes" are to be shown.

3.12 Instruction Books. Two instruction books shall be furnished with each VASI system ordered. Each book is to have a complete parts list, which includes the manufacturer's name and identifying part number, for each item listed, together with installation instructions for each installation. Also, provide a parts list and installation instructions with individual assemblies when shipped for maintenance or replacement purposes. Furnish sufficient drawings and instructions to indicate clearly the method of assembly and installation. Furnish sufficient schematic wiring diagrams and theory of operation to facilitate field repairs to all systems components.

4. QUALITY ASSURANCE PROVISIONS.

4.1 Quality Control Provisions. The manufacturer shall provide and maintain a quality control program in accordance with FAA-STD-013a.

4.2 Qualification Procedures. Manufacturers producing products, certified by the FAA as having met the requirements specified herein, will be listed as approved suppliers in Advisory Circular 150/5345-1, Approved Airport Lighting Equipment. Requests for qualification should be submitted, in writing, to the Airports Engineering Division, AAP-550, Office of Airports Programs, FAA, Washington, D.C. 20591, at least two weeks prior to start of qualification tests. The request shall include: (1) A statement that the manufacturer agrees to comply with all provisions of this specification; (2) A copy of proposed test procedures and test data sheets; and (3) A preliminary copy of the instruction book with drawings, photographs, and installation instructions to permit a preliminary analysis of the manufacturer's design. Successful completion of all tests specified herein, approval of the instruction book, and written agreement by the manufacturer to comply with all provisions herein are required for qualification. All tests may be witnessed by an authorized FAA representative and may be conducted at the manufacturer's plant or at an independent testing laboratory acceptable to the FAA. The manufacturer shall supply all test equipment and bear all testing costs. A certified copy of the test results of all qualification tests shall be submitted to the FAA. After successful completion of all tests, the manufacturer shall provide the FAA, free of charge, 10 copies of the final approved version of the instruction book. A product, once listed in Advisory Circular 150/5345-1, may not be changed as to design, method of manufacture, quality or quantity of materials, or substitution of components without prior concurrence of the FAA.

4.3 Qualification Tests. All tests as specified in paragraphs 4.5.1 thru 4.5.11 shall be conducted for qualification.

4.4 Production tests. The tests specified in paragraphs 4.5.1.2 and 4.5.8.1 shall be conducted, as a minimum, on all production units.

4.5 Test Procedures.

4.5.1 Visual Inspection.

4.5.1.1 Qualification Unit. The unit for qualification shall be visually inspected for conformance to the manufacturer's design and specification, including the adequacy of manufacturer-selected components and the establishment of agreement between the physical equipment, drawings, and parts list. The dimensions specified for the optical bench in the lamp housing assembly shall be checked for conformance.

4.5.1.2 Production Units. Each production unit shall be inspected against defects of workmanship and materials and for completeness and conformance with the design of the qualification unit.

4.5.2 Salt Spray Test. Salt spray test shall be performed in accordance with MIL-STD-810B, Method 509.

4.5.3 Rain Test. The manufacturer shall conduct such rain tests as deemed necessary to assure that equipment will operate properly without damage during conditons of severe thunderstorms. Rain test procedures will be subject to FAA approval.

4.5.4 Rigidity Test. A uniformly distributed sand load of 15 psf (73 kg/m^2) shall be applied over the entire top surface of the lamp housing. Before applying the load, the unit for qualification shall be set up as specified in paragraph 4.5.6, the lamps energized, and the light pattern displayed on a vertical surface 20 feet (6 m) from the aperture. The top, bottom, and the sides of the beam pattern and the transition lines shall be marked on the wall. The load shall then be applied by letting the sand pour down on the center of the lamp housing, preventing spill-over on the edges. After loading the unit with the required amount of sand, the load shall be left on five minutes. During the application of the load, upon full load, and upon removal of the load, the beam pattern and the transition lines shall remain within ±1/4 inch (0.6 cm) from the original markings.

4.5.5 Operation Test. The lamp housing shall be connected to its power source to test the lamp-out circuitry. The lamps shall be removed, one at a time, to check for proper operation. The tests shall be conducted for the day and nightime models of operation. For SAVASI and VASI-2 lamp housings, check the tilt switch system to determine compliance with paragraph 3.4.15.

4.5.6 Calibration of Aiming Bar. The lamp housing shall be set up on four mounting legs and aimed to a zero-degree setting by use of a transit. The transit shall be located 100 feet (30.5 m) in front of the lamp housing and sighted to align the bottom surfaces of the transition bar and aperture in a horizontal plane. The production model aiming bar shall then be placed in the lamp housing and its dial indicator set at zero degrees. The aiming bar level shall then be adjusted to center the bubble and the adjustment mechanism shall then be secured. The adjustment to the aiming bar shall not be changed

during the subsequent tests. The lamp housing shall then be re-aimed to an angle of 2 degrees using the production model aiming bar previously calibrated. The angular setting of the lamp housing shall then be checked by use of the transit and shall be within ±2 minutes of 2 degrees. The procedure shall be repeated for angles of 3, 4, 5, and 6 degrees. The transit may be moved in 50 feet (15 m) for the three higher angle tests.

4.5.6.1 Production Unit Tests of Aiming Bars and Calibration Bars. The calibration bar used for qualification shall be set up and leveled. The aiming bar, calibrated according to paragraph 4.5.6, shall be placed on the calibration bar with its dial set at zero degrees. Level the calibration bar so that the level bubble on the aiming bar is centered within ±2 minutes. This calibration bar can then be used as the standard for calibrating the production unit aiming bars. Production unit calibration bars shall be checked by repeating the above procedure with the aiming bar used for qualification. Alternative methods of checking the production unit aiming bars may be used where detailed procedures are submitted to and approved by the FAA.

4.5.7 Dielectric Test. A dielectric test shall be made on all power and control components and wiring of the qualification unit. The tests shall be made using 60 Hz AC voltage applied for 1 minute between insulated parts and ground.

All power wiring	1.5 KV
All control equipment and control wiring	0.5 KV

4.5.8 Performance Tests. The power and control assembly shall be connected to a load consisting of one or three PAR-64 lamps (as applicable) in each of its output circuits. The power and control assembly shall meet the performance requirements of paragraph 3.6.4.6 while the input voltage is externally adjusted through the range of plus or minus 10% of its designed value. The photosensing device shall be electrically connected to the assembly, and operation, within the footcandle limits as set forth in paragraph 3.6.4.4 of this specification, shall be demonstrated using the standard procedures for setting photoelectric controls contained in NBSIR 74/603.

4.5.8.1 Performance Tests, Production Units. Each production unit shall be connected to a power source and to a load. The circuit breaker shall be used for "on-off" control, and the photoelectric switching device shall be employed to check operation of all components at the two required intensity levels. At full load, the output currents or voltages shall be checked to determine conformance with the specifications.

4.5.9 High and Low Temperature Test. With the design input voltage set and the high and low light output intensities calibrated and set at 100% and at 10%, the entire power and control assembly shall be placed in an environmental chamber. The chamber shall be provided with a viewing window and provisioned for bringing in power and load leads. Temperature readings shall be required on the top of the control cabinet. Humidity and altitude controls are not required. The temperature within the chamber shall be raised to 55°C. ±1°. After a period of not less than 2 hours at this temperature, the loads shall be connected and the power and control assembly shall be energized for a period of not less than 6 hours. The loads shall be operated at the high current step during this test, except that periodically the photoelectric switching device shall be activated to prove continued operation of this device. Temperatures of the top of the case shall be observed on an hourly basis. After completion of this test, the temperature of the chamber shall be lowered to -43°C. ±1° and after 4 hours or more at this temperature, the power and control assembly shall again be energized for at least 2 hours and the photocell control unit activated to prove continued operation at low ambient temperatures. During the operating period of this test, the input voltage shall be regulated to within ±1% of design voltage. At no point shall the output current or voltage deviate more than ±1%. The movement of air through the environmental chamber shall not be greater than that necessary to maintain temperature, and at no time shall moving air be forced over the surface of the unit under test or over the photocell control unit controlling the power output level of the power and control assembly. The current through the loads shall be checked on an hourly basis and recorded on the test data sheet.

4.5.10 Transient Suppression Test. The power and control assembly shall be tested in accordance with method C506 of MIL-STD-462, including Notices 1, 2, and 3, to demonstrate that the transient suppression meets the requirements of paragraph 3.6.5. On completion of the transient suppression test, the power and control assembly shall meet the performance test of paragraph 4.5.8.

4.5.11 Photometric Tests. The lamp housing and optical bench shall be leveled as outlined in paragraph 4.5.6. The distance between the transition bar of the lamp housing and the detector, measuring the light intensity, shall be 100 feet (30.5 m). The center of the detector shall be set level with the center of the lamp housing aperture. After the lamp housing is connected to its power source, adjustments shall be made to the power unit to provide exact rated voltage or current to the lamps. Photometric tests shall be run three times with a random selection from the type of lamps specified for the unit. All tests shall meet the minimum photometric requirements illustrated in figure 2 or figures 3 and 4, as applicable.

4.5.12 Additional Tests. Make additional inspections and tests as deemed necessary by the Federal Aviation Administration, Office of Airports Programs, Washington, D.C., to determine compliance with this specification.

4.5.13 Guarantee. The manufacturer shall provide each customer with at least the following minimum guarantee: That the product has been manufactured in accordance with, and will perform as required by, the governing specification and that any defect in material or workmanship which may develop during proper and normal use during a period of one year from date of installation or a maximum of two years from date of shipment will be corrected by repair or replacement by the manufacturer f.o.b. factory.

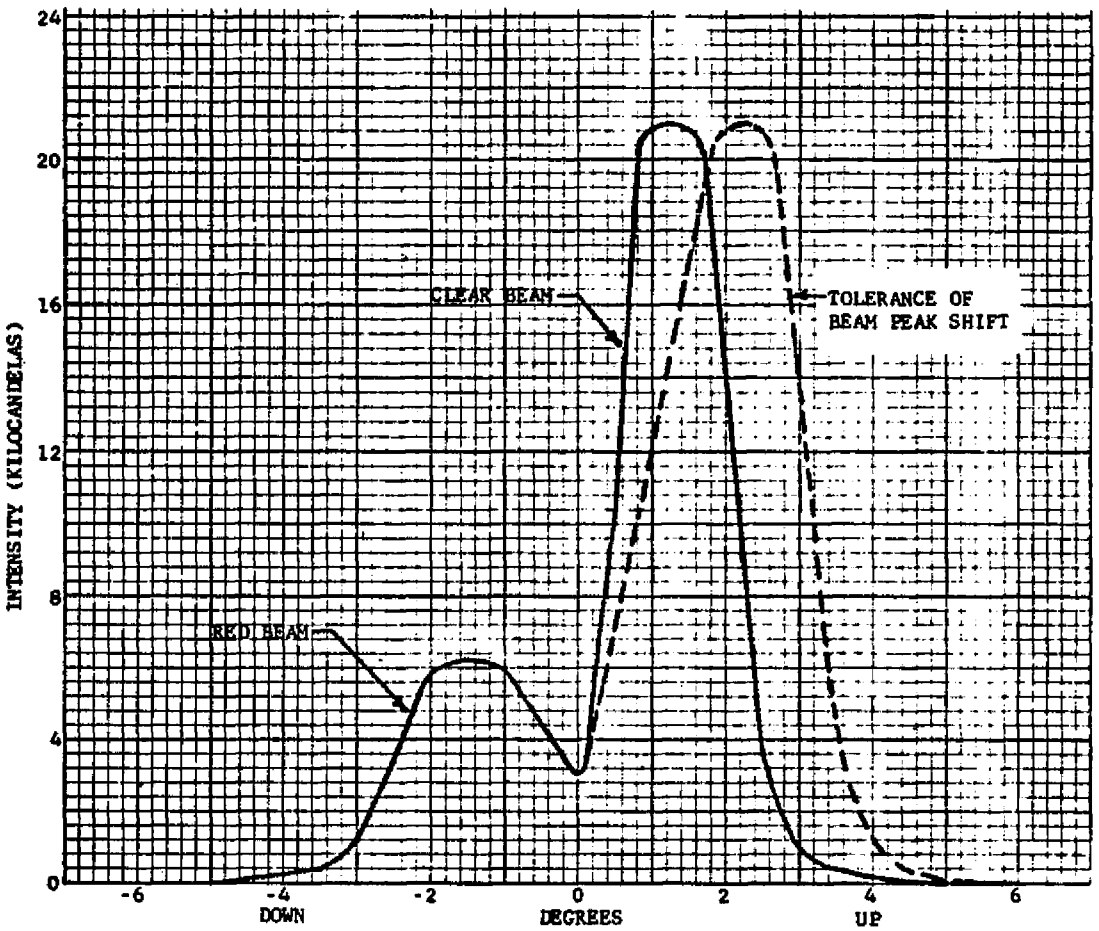


FIGURE 5. VERTICAL INTENSITY DISTRIBUTION FOR SAVASI.

★U.S. GOVERNMENT PRINTING OFFICE: 1977—240-897:92

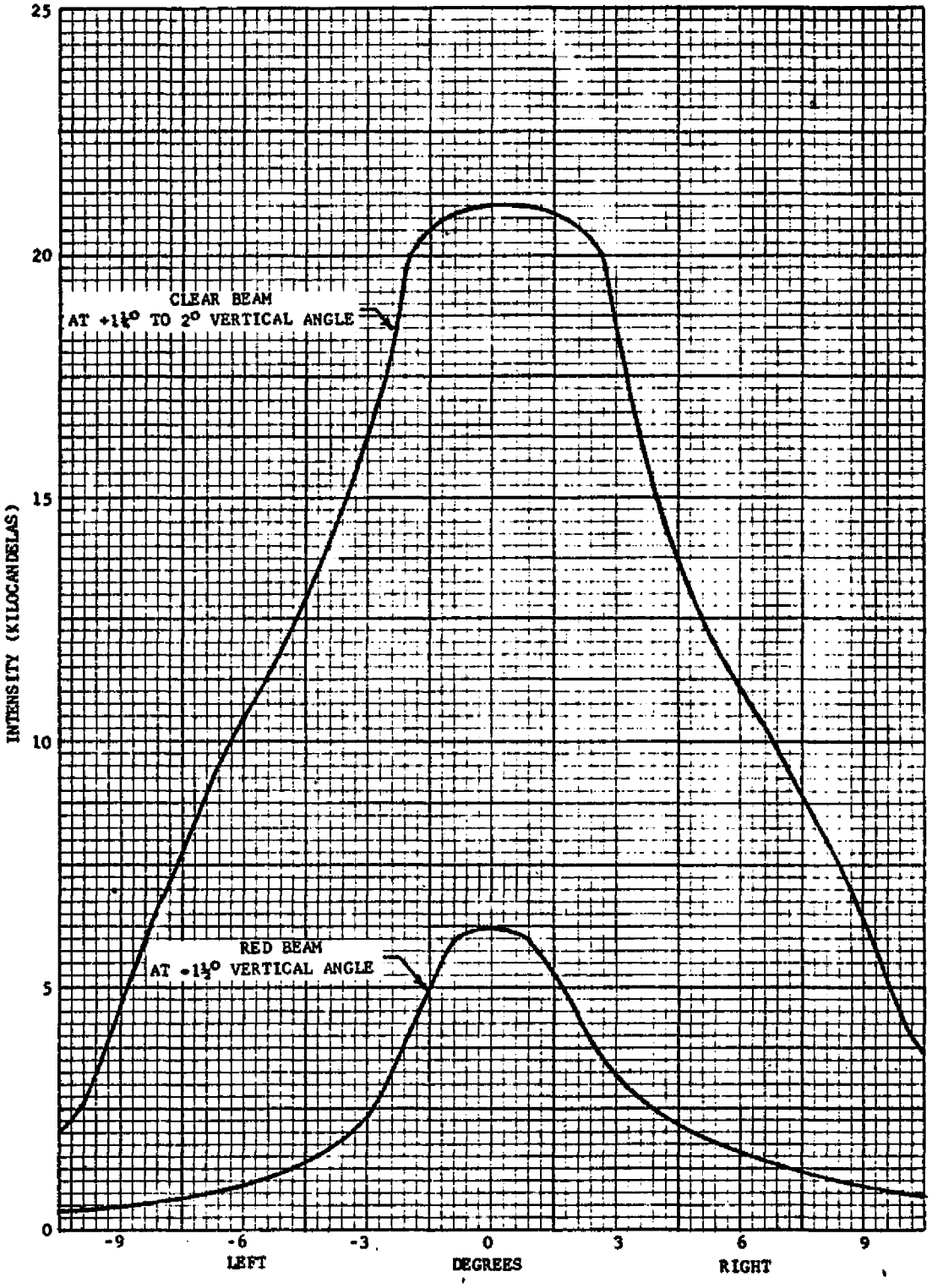
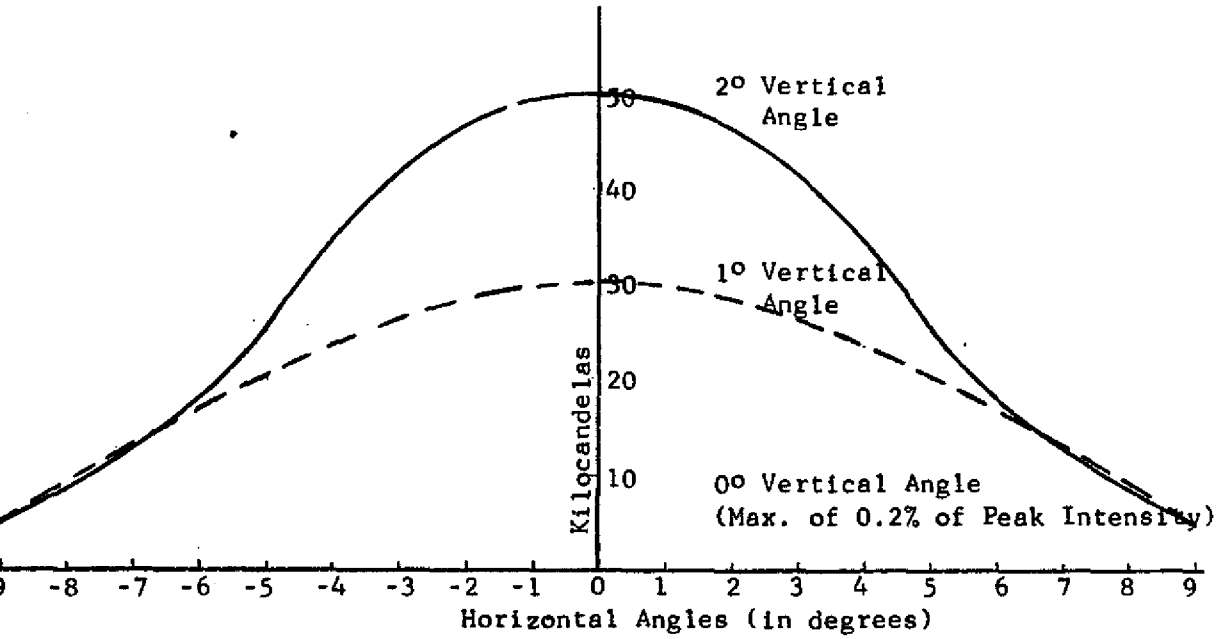
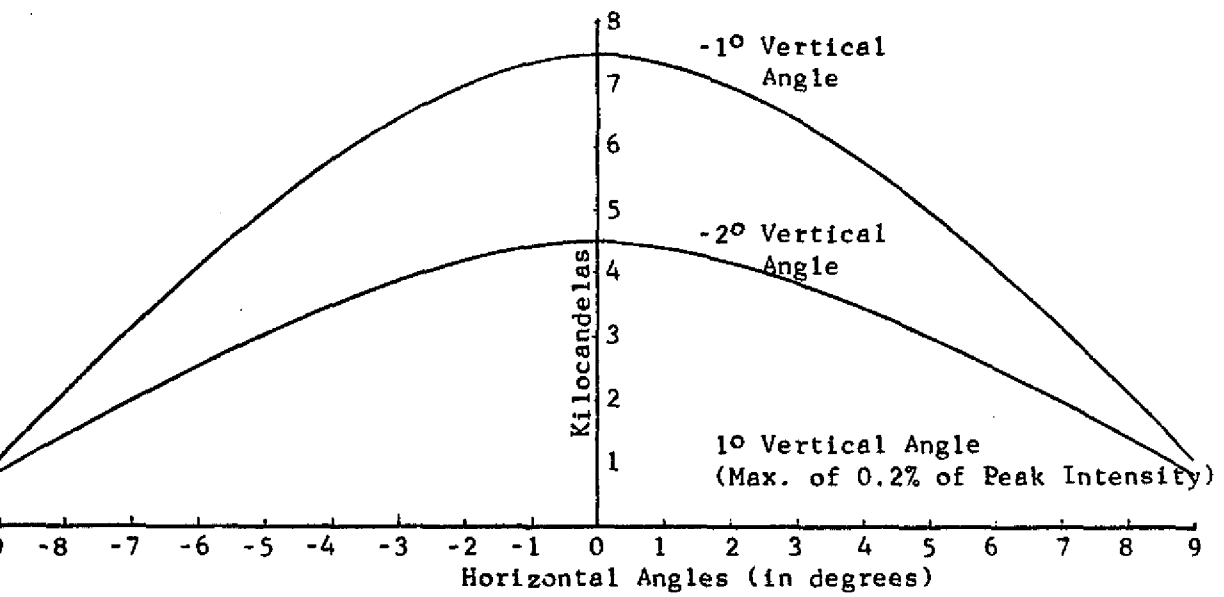


FIGURE 4. HORIZONTAL INTENSITY DISTRIBUTION FOR SAVASI.

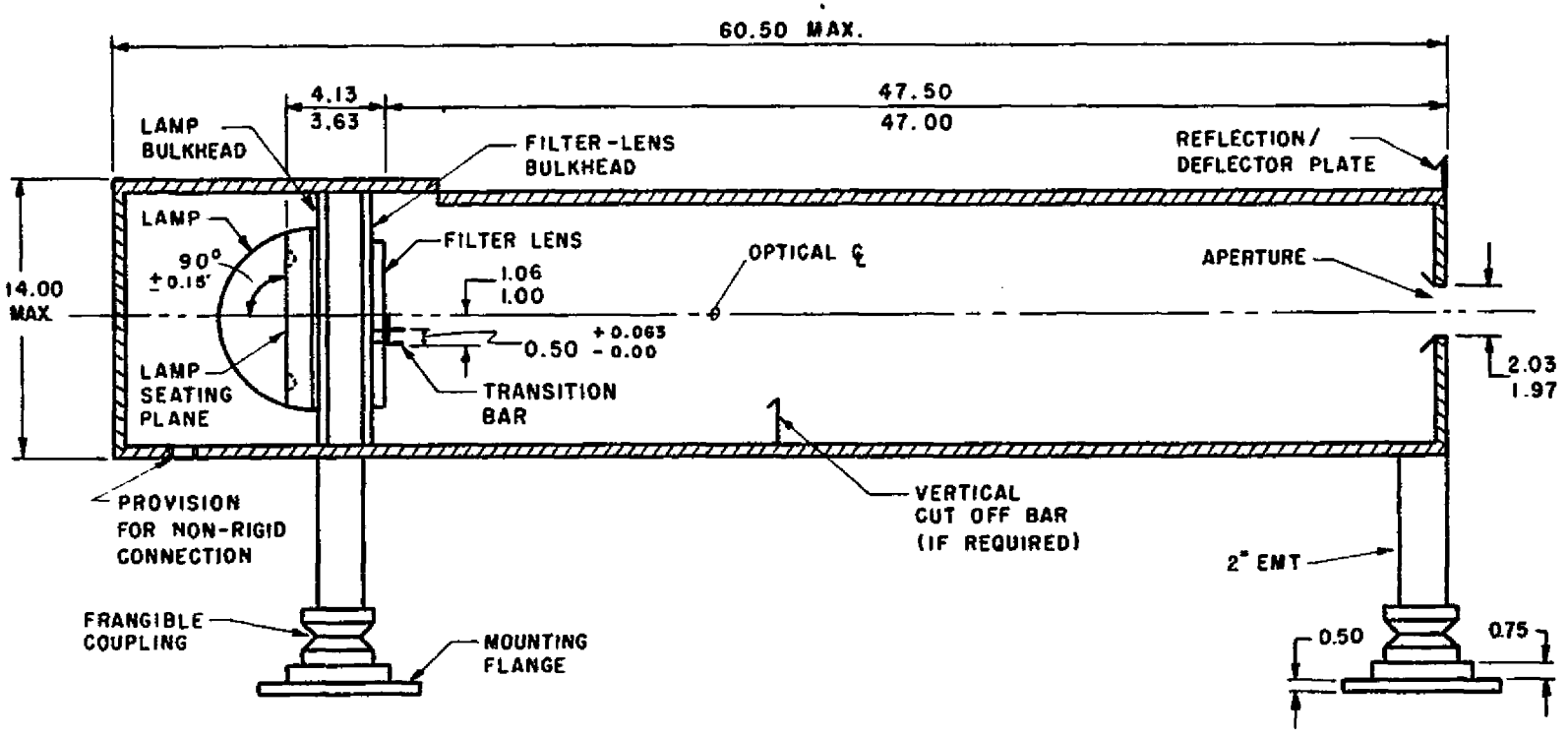


WHITE SIGNAL (Red Blocked)



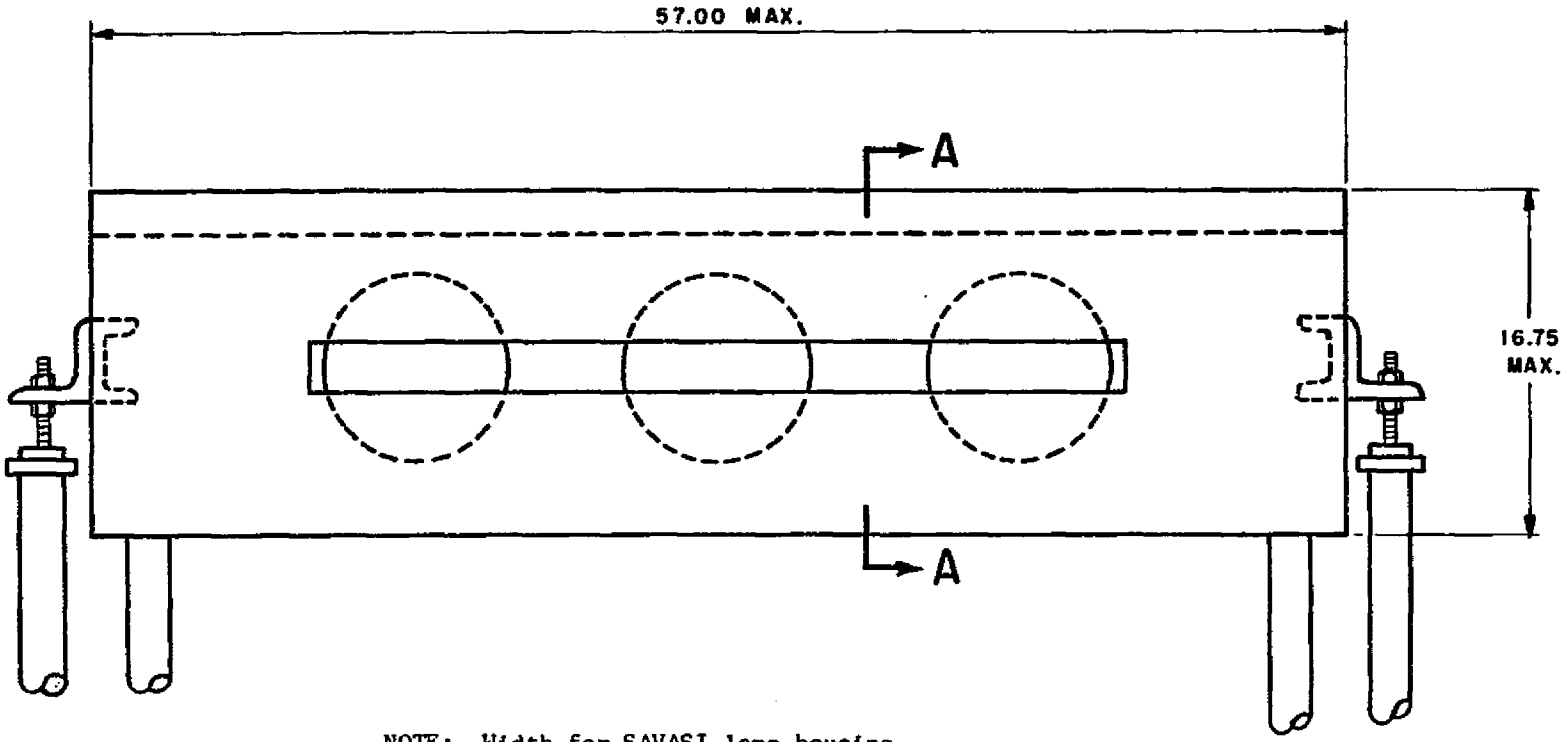
RED SIGNAL (White Blocked)

FIGURE 3. VASI PHOTOMETRIC REQUIREMENTS.



DIMENSIONS ARE IN INCHES

FIGURE 2. SECTION VIEW (A-A) OF TYPICAL LAMP HOUSING ASSEMBLY.



NOTE: Width for SAVASI lamp housing would be reduced to accommodate its single lamp.

DIMENSIONS ARE IN INCHES

FIGURE 1. FRONT VIEW OF TYPICAL LAMP HOUSING ASSEMBLY.

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
Washington, D.C. 20591

Official Business

PENALTY FOR PRIVATE USE, $300

POSTAGE AND FEES PAID
FEDERAL AVIATION
ADMINISTRATION

DOT 515