



FAA-E-2756B
May 25, 2004

DEPARTMENT OF TRANSPORTATION

FEDERAL AVIATION ADMINISTRATION

PERFORMANCE SPECIFICATION

FOUR BOX

PRECISION APPROACH PATH INDICATOR (PAPI)

WITHOUT REMOTE MONITORING SUBSYSTEM

(RMS)

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1.0 SCOPE

1.1 Scope.- This specification sets forth the requirements for a precision approach path indicator (PAPI) system that is used to provide accurate approach path guidance to pilots of landing aircraft. The PAPI system consists of four housing assemblies, a compact power and control assembly, and an aiming instrument set.

2.0 APPLICABLE DOCUMENTS

2.1 FAA Documents.- The following FAA specifications, standards, and drawings, of the issues in effect on the date of the invitation-for-bids or request-for-proposals, form a part of this specification and are applicable to the extent specified herein.

2.1.1 FAA Specifications.

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

2.1.2 FAA Standards.

- | | |
|-------------|---|
| FAA-STD-019 | Lightning and Surge Protection, Grounding, Bonding and Shielding Requirements for Facilities and Electronic Equipment |
|-------------|---|

2.1.3 FAA Drawings.

- | | |
|--------|---|
| C-6046 | Frangible Coupling, Types 1 and 1A, Details |
|--------|---|

2.1.4 FAA Management Documents. (Not Used)

2.2 Military and Federal Publications.- The following military and federal publications, of the issues in effect on the date of the invitation-for-bids or request-for-proposals, form a part of this specification and are applicable to the extent specified herein.

2.2.1 Military Specifications.

- | | |
|------------|--|
| MIL-A-8625 | Anodic Coatings, for Aluminum and Aluminum Alloys |
| MIL-C-5541 | Chemical Conversion Coatings on Aluminum and Aluminum Alloys |
| MIL-C-7989 | Covers, Light-Transmitting, for Aeronautical Lights, General Specification for |

2.2.1.1 Military Publications.

MIL-HDBK- 217	Reliability Stress and Failure Rate Data for Electronic Equipment
MIL-HDBK-472	Maintainability Predictions
MIL-HDBK-781	Reliability Test Methods, Plans, and Environment for Engineering Development, Qualification, and production

2.2.2 Military Standards.

MIL-STD-276	Impregnation of Porous Nonferrous Metal Castings
MIL-HDBK-454	Standard General Requirements for Electronic Equipment
MIL-STD-461	Electromagnetic Emission and Susceptibility Requirements for the Control of Electromagnetic Interference
MIL-STD-810	Environmental Test Methods
MIL-STD-889	Dissimilar Metals
MIL-STD-961	Department of Defense Standard Practice for Defense Specifications
MIL-STD-1472	Department of Defense Design Criteria Standard

2.2.3 Federal Specifications.

TT-P-1757	Primer Coating, Zinc Chromate, Low Moisture Sensitivity
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2.2.4 Federal Standards.

FED-STD-1005	Telecommunications: Coding and Modulation Requirements for Nondiversity 56,000 Bit/Second Modems
FED-STD-595	Color

2.2.5 Federal Communications Commission Rules and Regulations

Part 15 Subpart J	Radio Frequency Devices, Equipment Authorization Procedures
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2.3 Other Publications.- The following publications, of the issues in effect on the date of the invitation-for-bids or request-for-proposals, form a part of this specification and are applicable to the extent specified herein.

- 2.3.1 National Electrical Manufacturers Association (NEMA) standards.
 - NEMA 4 Watertight and Dust Tight Indoors and Outdoors (Enclosure)
- 2.3.2 American National Standards Institute.
 - ANSI C61.1 Quantities and Units Used in Electricity
- 2.3.3 National Fire Protection Association Publications.
 - NFPA No. 70 National Electrical Code
- 2.3.4 Masters Painters Institute (MPI).
 - QPL-TT-E-489-48, MPI # 48 Interior Alkyd, Gloss
 - MPI # 49 Interior Alkyd, Flat
- 2.3.5 American Society for Testing and Materials (ASTM).
 - B26 Aluminum-Alloy Sand Castings
 - B85 Aluminum-Alloy Die Castings
 - B108 Aluminum-Alloy Permanent Mold Castings
 - B209 Aluminum and Aluminum-Alloy Sheet and Plate
 - B211 Aluminum and Aluminum-Alloy, Bar, Rod, and Wire
 - B221 Aluminum and Aluminum Alloy Extruded Bars, Rods, Shapes and Tubes
 - B241 Pipe, Seamless, and Seamless Extruded Tube, Aluminum and Aluminum-Alloy
- 2.3.6 Institute for Printed Circuits: IPC-2221 Generic Standard on Printed Board Design
- 2.3.7 Society of Automotive Engineers.
 - SAE-AS25050 Colors, Aeronautical Lights and Lighting Equipment, General Requirements For
- 2.3.8 Underwriters Laboratories Inc: UL 1059 Terminal Blocks

(Copies of applicable FAA specifications, standards, and drawings may be obtained from the Contracting Officer in the Federal Aviation Administration office issuing the

invitation-for-bids or request-for-proposal, or contract involved, or other use to be made of the requested material.)

(Single copies of military specifications and standards may be obtained from the Federal Aviation Administration, Washington, D.C. 20590, ATTN: Contracting Officer. Requests should cite the invitation-for-bids, request-for-proposals, or contract for which the material is needed. Mail requests, if found acceptable, will be forwarded to a military source of supply for filling; hence, ample time should be allowed. Single copies of military specifications, standards, and publications may also be obtained directly from the Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, Pennsylvania 19120.)

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

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

(Copies of ANSI standards may be obtained from the American National Standards Institute, 70 East 45th Street, and New York 10017)

(Information on obtaining the National Electrical Code may be obtained from the National Fire Protection Association, Battery March Park, and Quincy Massachusetts 02269.)

3. REQUIREMENTS.

3.1 General Functional Requirements.- The precision approach path indicator (PAPI) system will be installed alongside a runway or at a heliport to provide accurate visual approach path information to pilots of landing aircraft, either day or night. The PAPI system shall meet the requirements specified herein, and shall consist of:

- (a) Four LHAs, with integral mounting and adjustment hardware (3.3).
- (b) One Power and control assembly (3.5).
- (c) One Aiming instrument set (3.7).

The PAPI signal presentations are shown in Figure 1 and the PAPI approach path (side view) in Figure 2).

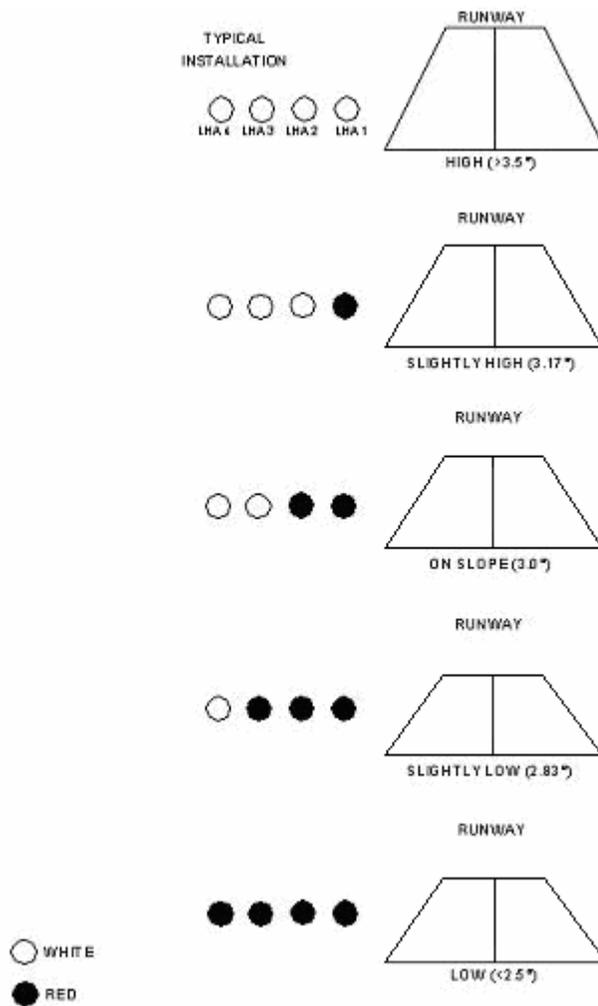


Figure 1. PAPI System Signal Presentations

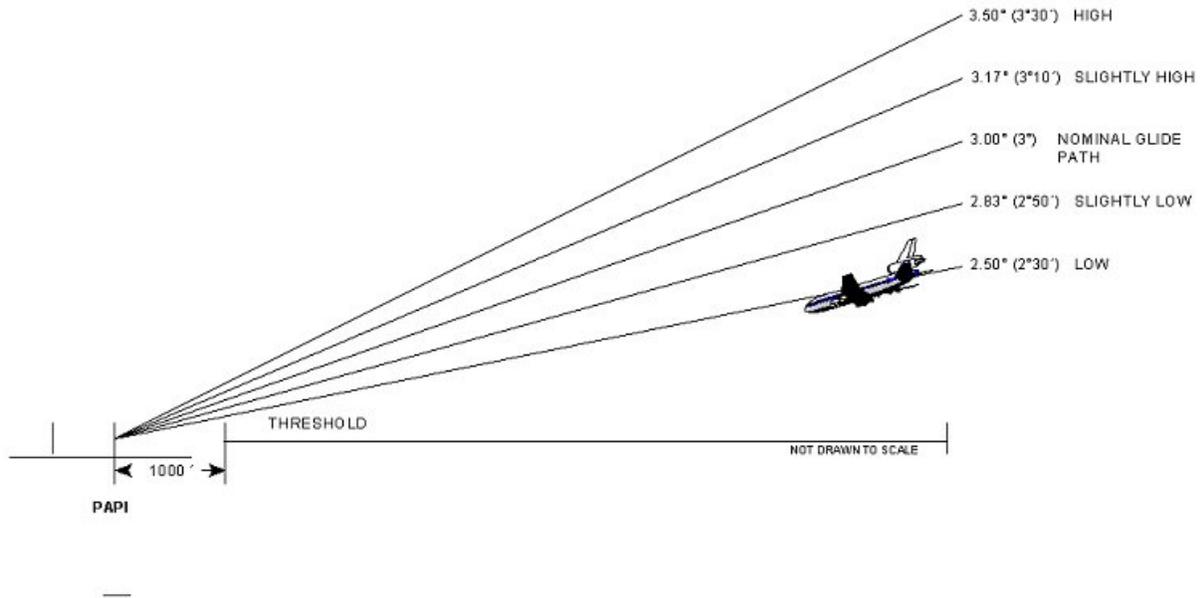


Figure 2. PAPI Approach Path (Side View)

3.2 Reserved.-

3.3 Lamp Housing Assembly.- The lamp housing assembly (LHA) shall consist of:

- (a) An optical bench that will permit the mounting of lamps, red glass filters, projection lenses, and adjustment hardware for the lamps. The optical bench shall be integral with aluminum walls or barriers that will compartmentalize the optical bench into sections (one for each lamp and its associated optical components). A transverse leveling pad and aiming pad compatible with the clinometer specified in Section 3.7.1 shall be an integral part of the optical bench.
- (b) A removable housing shell will be integral with a deflection plate (figures 3 and 4). The deflection plate is to prevent the pilot from seeing light reflected off the back of the PAPI and shall have a minimum height of 7% of the length of the housing shell (adequate protection up to 4 degrees above flight path).

The LHA shall be designed to maintain the required light beam orientation and photometric requirements as in Section 3.4 performing under the environmental conditions specified in 3.9.

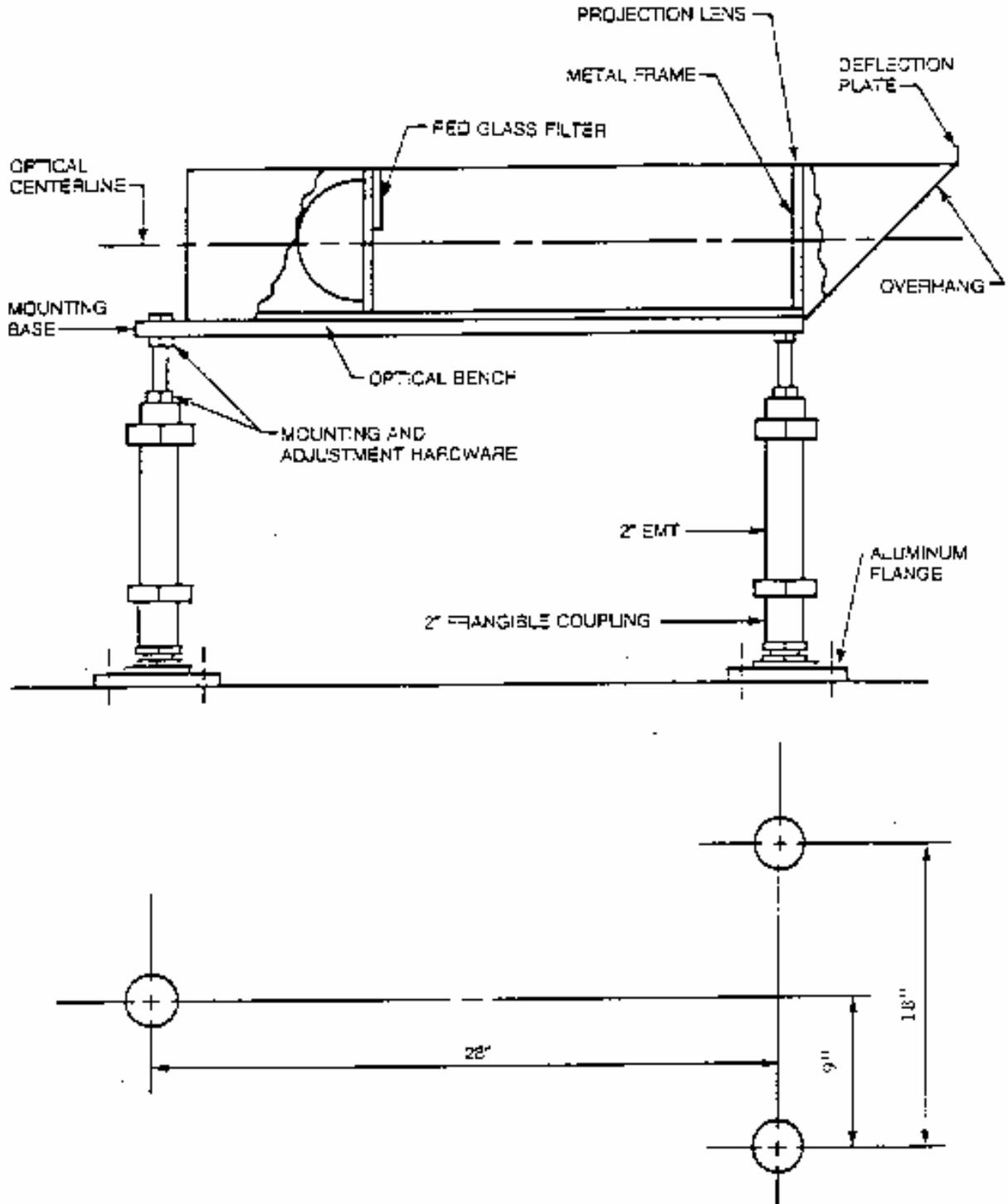


Figure 3. Lamp Housing Assembly (Side View)

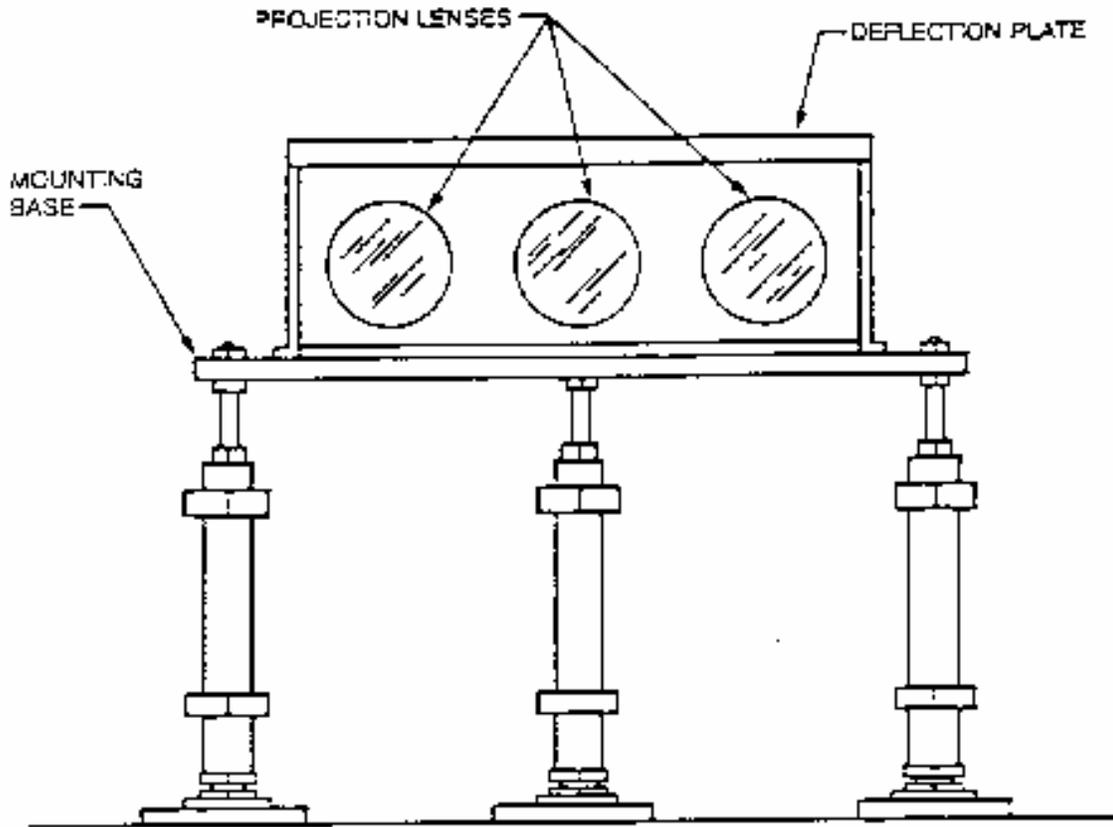


Figure 4. Lamp Housing Assembly (Front View)

3.3.1 Optical Bench.- The optical bench shall be constructed of non-corrosive metal and shall be of sufficient thickness, in conjunction with the structural design, to provide rigidity.

3.3.2 Housing Shell.- The optical bench shall be enclosed by a housing shell made of non-corrosive metal. The thickness of the housing shell material, in conjunction with the structural design, shall meet the requirements of 3.9.9. The maximum dimension of any drain hole shall be not greater than ¼ inch (6.35 millimeters (mm)) in diameter to prevent intrusion of foreign objects. Removal of the housing shall permit easy access to the lamps,

filter-lens assemblies, and electrical components mounted on the optical bench. The housing shell shall be installed on a mounting base to maintain the requirements of 3.4.4 over the expected life of the product, (see figures 3 and 4 by means of fasteners to discourage unauthorized persons from tampering with the equipment. The housing may be raised, instead of removed, to gain access to the optical and electrical components provided the raised housing can withstand winds of 100 MPH.

3.3.3 Lamp and Lamp Mounting.- The lamp shall have a rated life of 1000 hours when operated in the LHA on the high intensity setting. The lamps shall be quartz halogen 6.4A to 6.6A. The lamp leads shall be No. 16 American Wire Gauge (AWG) (minimum) insulated copper conductors. The lamp mounting shall permit firm and positive positioning of the three lamps. The lamp mounting shall be designed to facilitate lamp removal and replacement to meet the required Mean Time To Repair (MTTR) stated in Section 3.20.1(a) . The lamp removal must not exceed 5 minutes by a technician wearing gloves. Focusing of the optical system may be accomplished by adjusting the lamp, reflector, or filter.

3.3.4 Filter Assembly. – Three red, glass filter assemblies shall be supplied with each lamp housing assembly. The filters shall have a transmittance of at least 15 percent when the lamps are operated at full intensity. The filters and retaining hardware shall be positively keyed to ensure correct mounting in relation to the lamps. The filter assemblies shall be easily removable for replacement purposes.

3.3.5 Projection Lens.- The glass projection lenses shall be mounted in a vertical cast aluminum or stainless steel frame that will prevent any stray light from entering the LHA (figure 4). The lenses shall be recessed under an overhang to minimize the direct impingement or splash-back of rain or snow on the lenses. The overhang shall protrude beyond the front of the unit by a distance equal to or greater than the height of the housing shell.

3.3.6 Terminal Block.- A terminal block shall be provided in the rear of the lamp housing assembly. The terminal block shall provide non-corroding type terminals rated to carry 10 amperes (A) at 250 volts alternating current (VAC). Electrical contact surfaces of terminals shall be brass, bronze or copper that satisfy UL 1059 standard . Pressure screws of the electrical terminals shall be brass, bronze, or stainless steel that satisfy UL 1059 standard. The terminal block shall have sufficient terminals to accommodate all internal connections, plus connection of external power cables. External connections will be made using conductors ranging in size from No. 12 AWG to No. 8 AWG for power wiring and No. 18 or No. 20 AWG for signal wiring.

3.3.7 Power Input Cable Entrance Connector.- Space shall be reserved in the rear of the lamp housing assembly to permit connection of the incoming power cable to the terminal block. The cable shall enter through one hole located in the bottom rear of the housing. The hole shall be provided with a cable strain relief connector, firmly secured to the housing, and shall be designed to firmly secure a cable having a diameter of 0.3 to 0.5 inches (7.62 to 12.7 mm). The strain relief connector shall have a neoprene grommet to provide a compressive surface on the cable.

3.3.8 Weight.- The weight of the lamp housing assembly, excluding lamps and mounting legs, shall be not greater than 100 pounds (45 kilograms (kg)). This must be in accordance with MIL-STD-1472F section 5.9.11.3.

3.3.9 Mounting Provisions.- The lamp housing assembly shall be installed on the mounting base as shown in figures 3 and 4. The mounting base shall have three adjustable legs to permit aiming of the light beam to any vertical angle from 1.5° up to 6°. Also, the mounting and adjustment hardware shall permit transverse leveling where any mounting leg may be up to 1 inch (2.54 cm) higher or lower than any other leg after installation. The legs shall consist of mounting and adjusting hardware, 2-inch electrical metallic tubing (emt), frangible couplings conforming to FAA Drawing C-6046, and aluminum flanges.

3.3.10 Lampout Feature.- If series-connected lamps are used in the system design, switching devices shall be provided in the lamp housing assembly to automatically maintain circuit continuity when a lamp(s) fails, and to ensure continued operation of the remaining series-connected lamps.

3.3.11 Housing Shell Finish.- All aluminum exterior and interior surfaces of the lamp housing shell shall be pretreated with a chemical film in accordance with MIL-C-5541E, Class 1A or MIL-STD 8625F, and shall be sprayed with one coat of zinc chromate primer in accordance with Federal Specification No. TT-P-1757, composition L, color Y. As an alternate, the housing may be black anodized per MIL-A-8625 in lieu of painting the interior and prior to painting the exterior. Alternative finishing methods that provide the same level of protection or greater may be used upon approval of the agency.

3.3.11.1 Interior Finish.- The deflection plate and all interior surfaces of the aluminum housing shell, including the interior surface of the overhang, shall be painted with not less than a body coat and a finish coat of alkyd enamel in accordance with Master Painters Institute reference #49 , Black, color No. 37038 of FED-STD-595. The paint shall be applied to at least 2.5 mils (63.5 microns) thickness and the final painted surfaces shall be free of blotches, scratches, and runs. . Alternative finishing methods that provide the same level of protection or greater may be used upon approval of the agency.

3.3.11.2 Exterior Finish.- All exterior surfaces of the housing shell, shall be painted with not less than a body coat and two finish coats of alkyd baking enamel in accordance with QPL-TT-E-489-48, MPI # 48 , Class B, International Orange, Color No. 12197 of FED-STD-595. The paint shall be applied to at least 3.0 mil (76.2 microns) thickness and the final painted surfaces shall be free of blotches, scratches, and runs. Alternative finishing methods that provide the same level of protection or greater may be used upon approval of the agency.

3.3.12 Optical Bench Finish.- The optical bench including the lamps and projector mounting frames shall be painted as described in 3.3.11.1. As an alternate, the optical bench may be black anodized per MIL-A-8625 in lieu of painting.

3.3.13 Mounting Base Finish.- The LHA mounting base shall be painted as described in 3.3.11.1.

3.3.14 Tilt Switch.- Each lamp housing assembly unit shall have a tilt switch in the unit. The tilt switch system shall de-energize the lamps when the optical pattern is lowered between 1/4 and 1/2 degree or raised between 1/2 and 1 degree with respect to the preset aiming angle. The tilt switch shall have a time delay of at least 10 seconds that will prevent intermittent tilt switch activation due to vibration. The tilt switch shall have fail-safe operation so that any malfunction of the tilt switch, including loss of input power, shall de-energize the lamp circuit in all indicators.

3.4 Photometric Requirements.

3.4.1 Light Beam.- The LHAs shall provide a split beam of light consisting of white light in the top sector and red light in the bottom sector as viewed from the front. The transition from red light to white light shall occur within an angle of 3 minutes of arc at the beam center and within an angle of 5 minutes of arc at the beam edges. The transition band shall be flat to within 3 minutes of arc. The PAPI shall provide usable visual approach guidance out to at least ± 10 degrees either side of the extended runway centerline.

3.4.2 Light Intensity.- Each LHA shall contain three lamps. Each LHA shall meet the minimum intensity requirements, as shown in figure 5, while operating at 6.4A root mean square (rms) (high intensity). The method of controlling the lamp intensity shall not decrease the lamp manufacturers 1000-hour sinusoidal waveform life expectancy for the lamps.

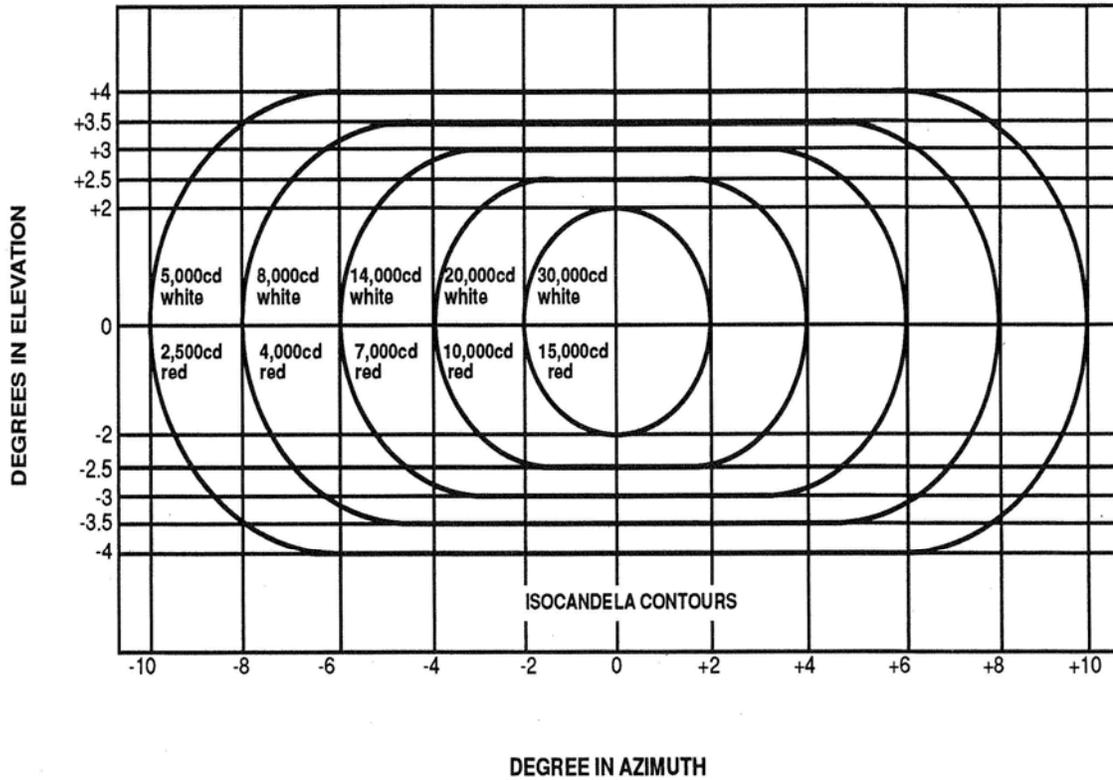


Figure 5. Light Intensity Requirements for PAPI

3.4.3 Light Colors.- The light colors shall be aviation white and aviation red as defined in SAE-AS25050, Colors, Aeronautical Lights and Lighting Equipment, General Requirements for, paragraph 3.1, Aviation Colors.

3.4.4 Light Beam Aiming Tolerance.- The centerline of the transition zone (i.e. the vertical area of change from red light to white light) of each LHA projected light signal shall be parallel to the zero aiming angle projection within plus or minus five (5) minutes of arc. This is to be interpreted to mean that the projected vertical transition zone signal angle will be coincident with the LHA aiming angle to the tolerance stated, and is a measure of the aiming accuracy of the LHA/Aiming device combination.

3.5 Power and Control Assembly.

3.5.1 General.- The power and control assembly shall control the supply of 4.5A rms (low intensity) or 6.4A rms (high intensity) service to the lamps (Figure 6). The power and control assembly shall form one compact, light weight, self-cooled unit that will be installed adjacent to the LHA furthest from the runway. Detailed description of components and requirements are provided in the following subparagraphs. The weight of the power and control assembly shall not exceed 50 pounds (22.67 kg).

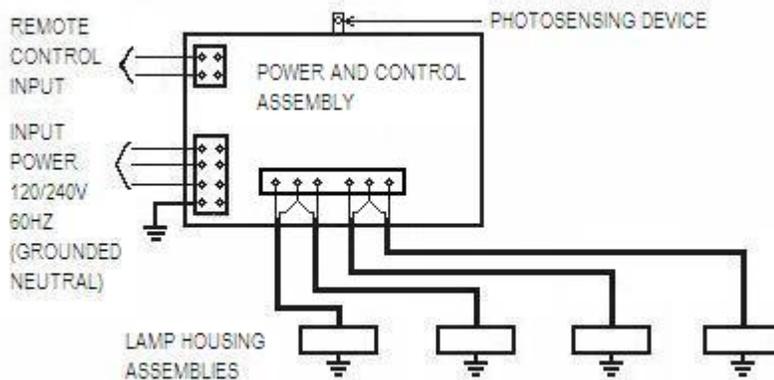


Figure 6. Functional Relationship of PAPI Units

Figure 6. Functional Relationship of PAPI Units

3.5.2 Operational Requirements.- The power and control assembly shall supply power for operation of the PAPI system at two light intensity steps as follows: 95 to 100 percent (6.4A rms) for daytime operation and approximately 8.5 percent (4.5A rms) for night operation. The intensity of the lights shall be controlled by the photoelectric switching circuitry (3.5.3.1.4). The ON/OFF operation of the PAPI system will be controlled by the remote control input signal (120 VAC, 60Hz). The 120/240 volt, 60Hz input power lines (with Neutral grounded in accordance with National Electric Code) shall terminate at the input terminal block (3.5.3.1.1), and shall be connected to internal circuitry of the power and control assembly through a 2-pole main circuit breaker (3.5.3.1.2). The power and control assembly shall provide two separate, constant, root mean square output currents (of 6.4A or 4.5A) to each of two respective, two-wire output circuits, as determined by the photoelectric switching circuitry. The crest factor of the output voltage waveform shall be no greater than 1.1 and the voltage distortion relative to a sine wave shall be not greater than 10 percent of Total Harmonic Distortion Voltage (THDV). The system shall recover automatically from momentary power interruptions.

3.5.3 Power and Control Assembly Cabinet.-The power and control assembly cabinet shall contain all power and control components (3.5.3.1), including terminal blocks, cable clamps, grounding lugs, and protective devices. The cabinet shall be an outdoor, liquid-tight, aluminum National Electrical Manufacturers Association (NEMA-4X) type enclosure of sufficient size. All plane surfaces of the control cabinet shall intersect at 90°. If used, the thyristors shall be mounted within the enclosures and adequate heat sinks shall be provided. Proper high-temperature wire in accordance with National Electric Code Article 310 (see Tables 310-13 and 310-61) shall be used throughout the cabinet. 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 a three point latch set with provision for padlocking. The padlock hasp shall have a 7/16 inch (11.1 mm) hole. (Padlocks are not furnished under this specification). The door shall open a minimum of 110° and shall be equipped with a mechanism to ensure the door remains open and can withstand winds of 100MPH. The internal face portion of the door shall be provided with a pocket to hold a wiring diagram (3.17.3). The door of the cabinet shall be bonded to the body of the cabinet in accordance with National Electric Code (NEC) Article 250-90 (2002). An internal ground lug shall be provided in the cabinet for grounding purposes. The ground lug shall have a slotted, green-colored head suitable for a No. 6 American Wire Gauge bare copper ground wire. Electronic components shall be mounted on plug-in printed wiring boards whenever practicable. All adjustments located on printed wiring boards shall be readily accessible to the operator. Adjustments shall be made without the need to use extender card or cable.

3.5.3.1 Components.

3.5.3.1.1 Terminal Blocks.- One input/output terminal block of the enclosed base type, with screw-pressure terminal, shall be provided. The three input positions shall be suitable for No. 4 AWG through No. 8 AWG standard conductors. Signal wiring from the LHA to the PCA shall be No. 18 AWG or No. 20 AWG. Each pressure- type terminal shall be equipped with a pressure plate to prevent the tip of the screw from turning directly on the wire. Separators are required between the terminals; the separators shall be integrally 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 3.17.3.

3.5.3.1.2 Circuit Breaker.- A properly rated two-pole, molded-case, Thermal-magnetic circuit breaker or electronic solid state type shall be provided as a main circuit breaker and power switch. The circuit breaker shall have an arc quenching chamber and shall have a minimum rating of Asymmetrical interrupting capacity (AIC) of 10,000 A (10KA) at 250V, 60Hz.

3.5.3.1.3 Thyristors.- Thyristors, if used, shall have a minimum peak repetitive off-state voltage (V_{DRM}) rating of 600V and a minimum rms on-state current (I_T) rating of 25A. Thyristors shall have suitable heatsinks to ensure operation within the thermal constraints of the particular device selected. The thyristors selected shall not be damaged by the currents or voltages encountered when one or more lamps fails.

3.5.3.1.4 Photoelectric Switching Circuitry.- A photoelectric switching circuitry shall be provided to change automatically the intensity of the lights in two steps as described below. All operating components of the switching circuitry, except the photo sensing device (3.5.3.1.5) and any associated signal conditioning circuitry, shall be mounted on a printed wiring board mounted within the cabinet. The photoelectric switching circuitry shall set the output current to 6.4A rms when the illumination on a vertical surface facing north reaches 58 ± 2 foot-candles (624 ± 21.5 lux), and shall set the output current to 4.5A rms when the illumination falls to 35 ± 2 foot-candles (377 ± 21.5 lux). The on-off points shall vary not greater than ± 2 foot-candles (± 21.5 lux), at any ambient temperature ranging from -55° Centigrade (C) (-67° Fahrenheit (F)) to $+70^\circ$ C ($+158^\circ$ F) with line voltage variations from 115V to 125V. Similarly, the on-off points shall vary not greater than 3 foot-candles (32.28 lux) with line voltage variations from 108V to 115V and from 125V to 132V. A symmetrical

time delay of 5 to 8 seconds shall be provided to prevent the output current from changing due to transient light conditions. A fail-safe feature shall set the output current to 4.5A in the event the photo sensing device fails.

3.5.3.1.5 Photo sensing Device.- The photo sensing device shall be mounted on the top surface of the PCA cabinet and shall be able to rotate and to lock in position. The device shall be hermetically sealed, and shall have a spectral response which peaks in the 5500 - 6000 angstroms (0.021 - 0.023 mil) region. The device shall meet the temperature requirements of the photoelectric switching circuitry (3.5.3.1.4). The device shall activate the photoelectric switching circuitry (3.5.3.1.4).

3.5.3.1.6 Current Control Device.- A load current-sensing control device shall be provided to vary automatically the conduction of the thyristors in order to maintain a constant rms load current through the lamps of the lamp housing assemblies. All operating components shall be mounted on plug-in printed wiring boards, whenever practicable. The boards shall be mounted within the cabinet. Potentiometers shall be provided for setting the load currents. One potentiometer shall be provided for adjusting the 6.4A current and a separate, independent potentiometer shall be provided for setting the 4.5A current. The potentiometers shall have a control range to accommodate a ± 10 percent minimum variation in load. Each thyristor shall have a separate current control device. Monitor points shall be provided to monitor the output current, and shall drive the true rms output current indicating meter (3.5.3.1.9). The output of the monitor device shall be scaled to read equivalent rms current with a high input impedance (1 megohm minimum) digital voltohmmeter (vom) when adjusting the current control potentiometer. The current control device shall regulate the true rms values of each level of the two separate output currents to within ± 4 percent under the following conditions: (a) for any combination of the environmental conditions set forth in 3.9, (b) for power line input voltage variation between 216 V and 264 V and the transient recovery requirements of 3.10, and (c) when two lamps fail or when two lamps are removed from a loop. The current control device shall limit the maximum rms value of the output current to no more than 1 ± 10 percent of the nominal load current of 6.4A rms, regardless of the output current and voltage waveform, input current and voltage transients, and ± 10 percent variation from nominal input voltage. An overcurrent protection feature shall be incorporated into the design of the current control device.

3.5.3.1.7 Elapsed Time Indicator.- An elapsed time indicator shall be provided to register the number of hours of operation during the high-intensity setting. The meter shall operate on 120 V, 60 Hz power and shall indicate total time in hours and 10ths of hours. The meter shall be recyclable and shall have a minimum indicator range of 9,999.9 hours. The meter shall be mounted within the cabinet.

3.5.3.1.8 Power Supply.- A power supply shall be provided to supply the proper voltages and currents necessary to operate the power and control assembly circuits within the tolerances and conditions set forth in this specification. Wherever practicable, all electronic components shall be mounted on a plug-in printed wiring board mounted within the cabinet.

3.5.3.1.9 RMS Output Current Meter.- One panel-mounted true rms indicating meter with calibration marks at 6.4A and 4.5A shall be provided for the series-connected lamps. There shall be a provision to calibrate the meter. The 6.4A indication shall be in the upper 60 percent of the meter scale. The meter shall have an accuracy of ± 2 percent of reading. The

meter scale from zero to full scale shall be 120° with 0.1A markings that will be highlighted by a reflective mirror. The rms output current meter shall indicate the output current from the power and control assembly. A three position switch shall be provided that will switch the meter to either one of the two output circuits or to the off position.

3.5.4 Power and Control Assembly Finish.- All aluminum exterior and interior surfaces of the power and control assembly shall be pretreated with a chemical film in accordance with MIL-C-5541, Class IA. All aluminum exterior surfaces of the control cabinet shall be sprayed with one coat of zinc chromate primer in accordance with 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 two finish coats of alkyd baking enamel (in accordance with QPL-TT-E-489-48, MPI # 48, Aviation White, Color No. 17875 (in accordance with FED-STD-595). The paint shall be applied to at least 3.0 mil (76.2 microns) thickness and the final painted surfaces shall be free of blotches, scratches, and runs. The interior surfaces of the control cabinet shall be painted with not less than a body coat and two finish coats of alkyd baking enamel (in accordance with QPL-TT-E-489-48, MPI #48), Aviation White, Color No. 17875 (in accordance with FED-STD-595). Aluminum surfaces that are clear anodized in accordance with MIL-A-8625, Type II do not require painting. Alternative finishing methods that provide the same level of protection or greater may be used upon approval of the agency.

3.6 Interchangeability.- All parts of the unit furnished under a single procurement shall be manufactured to a tolerance that shall permit interchangeability of any part with like part of any other unit. Identical components shall be identified with identical parts numbers and unlike parts shall not have the same part number. This requirement does not prevent the readjustment or calibration of exchanged modules nor does it prohibit exchange of control panels due to the runway identification number. Interchangeability shall be in accordance with MIL-HDBK-454, Requirement 7.

3.7 Aiming Instrument Set and Calibration Bar.- An aiming instrument set, consists of a clinometer, calibration bar and a portable storage case.

3.7.1 Clinometer.- The clinometer shall be used to adjust accurately the LHA during cross-leveling (lateral), longitudinal leveling, and elevation setting. The base of the clinometer shall be rustproof. The clinometer shall be constructed of non-corrosive metal to provide a light-weight 10 lbs (4.5kg) maximum rugged instrument. Design and construction of the clinometer shall be such that deviation from true position due to its own weight shall be not greater than 3 minutes of arc when the clinometer is placed on the optical bench (3.3.1). An accurate direct-reading dial shall be provided for setting the LHA to the desired angle. The reading dial shall indicate angles from 1.5° to 6° in graduated increments of 0.10°. The spacing between each degree mark shall be at least 1/2 inch (12.7 mm). A 0.00° setting shall be provided on the dial for calibration purposes and shall have an accuracy of ±2 minutes of arc and a repeatability of ±1 minute of arc while on the calibration bar. Alternate designs using a vernier dial may be used, so long as the vernier dial is provided with equivalent graduations as specified for the direct reading dial. The clinometer shall be designed so that repeated changing of the dial setting will not cause excessive wear that could deteriorate the accuracy of the instrument. Aluminum and other soft metals shall not be used where subject to metal-to-metal rubbing. The clinometer shall have provisions for firmly securing the dial setting after factory calibration, but shall permit field adjustment to the 0.00° position by the

user. The clinometer shall utilize a 6-inch (15.24 cm) (maximum) level having an accuracy of ± 2 minutes. The level shall be permanently attached to the clinometer to permit fine adjustments to calibrate the instrument. The level shall have a protective device to minimize possible damage.

3.7.2 Calibration Bar.- A calibration bar shall be provided with each clinometer to permit field checking and calibration. The calibration bar shall be designed for laying on a flat surface or in the carrying case (see 3.7.3) and shall have adjustment features to permit it being leveled to a horizontal plane. The tolerance for the flatness of the calibration bar shall be $\leq .005$ ". A portable 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 clinometer in 3.7.1, with a metal base meeting the requirements of paragraph 3.13.1. The level shall be used to verify the calibration of the clinometer.

3.7.3 Carrying and Storage Case.- A rigid portable non-corrosive metal or fiberglass case shall be provided for carrying and storing the clinometer. The case shall have a carrying handle and shall have a suitable latch for securing the cover in the closed position. The interior shall be designed to accommodate the clinometer so that it will be held and cushioned firmly in place.

3.7.3.1 Carrying and Storage Case Finish.- All aluminum exterior and interior surfaces of the carrying and storage case shall be pretreated with a chemical film in accordance with MIL-C-5541, Class 1A. All aluminum exterior surfaces shall be sprayed with one coat of zinc chromate primer in accordance with Federal Specification No. TT-P-1757, composition L, color Y. Following the application of the primer, the exterior surfaces of the carrying case shall be painted with not less than a body coat and two finish coats of alkyd baking enamel in accordance with QPL-TT-E-489-48, MPI # 48, Class B, International Orange, Color No. 12197 of FED-STD-595. The paint shall be applied to at least 2.0 mil (76.2 microns) thickness and the final painted surfaces shall be free of blotches, scratches, and runs. As an alternate, the aluminum carrying and storage case may be anodized in accordance with MIL-A-8625, Type II, Clear, or a plastic case may be used instead of an aluminum case.

3.8 Reserved.

3.9 Environmental Requirements.- The equipment shall be designed for outdoor installation and continuous or intermittent operation under the environmental conditions specified below.

3.9.1 Temperature.- The temperature range shall be from -55°C (-67°F) to $+65^{\circ}\text{C}$ ($+149^{\circ}\text{F}$). The clinometer (Para 3.7.1) shall meet all the performance requirements of 3.7.1 when operated over this temperature range.

3.9.2 Altitude.- The pressure altitude shall range from sea level to 10,000 feet (3,048 meters).

3.9.3 Temperature Shock (Thermal Shock).- The system external surfaces (including projection lenses) shall be exposed to a sudden application of cold water at a temperature of 0° to $+5^{\circ}\text{C}$ when the lights reach stable operating temperatures at 20°C ambient temperature.

3.9.4 Humidity.- Relative humidity shall be up to 100 percent, including conditions where condensation takes place in the form of both water and frost.

3.9.5 Sand and Dust.- The system shall be exposed to windblown sand and dust particles as may be encountered in arid regions.

3.9.6 Rain.- The system shall be capable of withstanding windblown rain.

3.9.7 Salt Spray.- The system shall be exposed to salt-laden atmosphere with relative humidity as stated in 3.9.4.

3.9.8 Solar Radiation (Sunshine).- The system shall be exposed to sunshine with ambient temperatures as stated in 3.9.1.

3.9.9 Vibration.- The LHAs and the PCA shall be capable of withstanding vibrations in the frequency range of 10 to 2,000 Hertz. See paragraph 4.5.10(b) for limits.

3.10 Transient Suppression.- The equipment shall be designed to suppress switching transients, and to withstand transient increases superimposed on the 120/240 VAC rms power line input voltage that reach a peak value of 500 V for as long as 50 milliseconds. In addition, the equipment shall be designed to withstand lightning transients superimposed on each input power line. These transients shall be characterized as 8 by 20 microseconds (wave form) current surges of 10,000 amperes with the subsequent power-follow currents and voltage surges of up to 10 kV/microsecond (minimum). The current surge waveforms are described in ANSI Standard C61.1. The equipment shall recover and resume normal operation automatically within 3 seconds (transient recovery time) when an interruption or a shutdown is experienced due to a lightning transient. Equipment performance and operational functions shall not be degraded beyond the specification requirements by the above transients when each type of transient is superimposed a minimum of five times on each power input terminal while the equipment is energized. Transient suppression devices shall be provided for all power lines at their first point of interface with the equipment. The return for the lightning transient protection devices shall be connected to earth ground via a separate dedicated ground lug that will accommodate not less than a No. 6 AWG conductor. The transient protection for signal lines and the LHA power lines shall be in accordance with FAA-STD-019, Lightning and Surge Protection, Grounding, Bonding and Shielding Requirements for Facilities and Electronic equipment.

3.11 Electromagnetic Interference Control.- Conducted interference levels on incoming ac power leads, control leads, and signals leads shall be not greater than the limits for CE102 as defined in MIL-STD-461E, except that above 150 kilohertz (kHz) the limits are allowed to be 20 (dB) below the prescribed values. Similarly, radiated emission over the frequency range of 30 kHz to 400 megahertz (MHz), at a distance of 20 feet (6.1 meters) shall be no greater than the limit for RE102 of MIL-STD-461E.

3.12 Electrical Components.- Electrical components must meet the requirement specified herein unless otherwise noted.

3.12.1 Reserved.

3.12.2 Reserved.

3.12.3 Reserved.

3.12.4 Reserved.

3.12.5 Reserved.

3.12.6 Electrical Connectors.- Electrical connectors shall be in accordance with FAA-G-2100G section 3.3.1.3.3.

3.12.7 Printed Wiring Boards.- Printed wiring boards, assemblies and components mounting shall conform to FAA-G-2100G, paragraphs 3.2.2.1 and 3.2.2.2, with the exception of paper base copper-clad laminates which are prohibited. Conformal coating is required and shall be in accordance with FAA-G-2100G paragraph 3.3.1.3.7b.

3.12.8 Component Ratings.- When component ratings are not specified, they shall be selected to ensure that the components are not operated in excess of 80 percent of their normally derated maximum values for the temperatures encountered under the specified equipment environmental conditions. Derating of electronic components shall be in accordance with MIL-STD-454, Requirement 18.

3.12.9 Reserved.

3.13 Materials and parts.- Materials and parts shall be as specified herein. Materials and parts not specifically designated by standard or specification shall meet the requirements of FAA-G-2100G Section 3.3.1. All materials and parts shall be suitable for operation under the environmental conditions specified in 3.9.

3.13.1 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-889B section 5.1 Parts may be suitably coated to prevent corrosion or seizing of parts that require removal for servicing.

3.13.2 Aluminum.- Aluminum shall be in accordance with American Society for Testing and Materials (ASTM) B241, B221 and B211. Aluminum alloy plate and sheet, aluminum alloy die castings, and aluminum alloy sand castings shall be in accordance with ASTM B 209, B26, B108, B85. Aluminum alloy castings, if used, shall be impregnated in accordance with MIL-STD-276.

3.13.3 Optical covers.- Light transmitting covers shall conform to the requirements of MIL-C-7989B section 3.5.2.

3.13.4 Gaskets.- Gaskets used at separable joints for cushioning and sealing purposes shall be made of neoprene and shall be suitable for use at ambient temperatures of -55°C (-67°F) to + 65°C (+149°F)

3.13.5 Nameplates.- Nameplates conforming to FAA-E-2100G paragraph 3.3.3.1 shall be installed at convenient locations on the LHA, the carrying and storage case, and the power and the control assembly. Each nameplate shall be attached to each assembly with four aluminum rivets or drive screws.

3.13.5.1 Instruction plate.- The 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. The instruction plate shall be made of aluminum.

3.14 Brazing.- Brazing shall be in accordance with MIL-HDBK-454, Requirement 59, except that electrical connections shall not be brazed. Paragraph 3.3 of Requirement 59 is not applicable.

3.15 Soldering.- Soldering shall be in accordance with MIL-HDBK-454, Requirement 5.

3.16 Reserved.

3.17 Assembly, Wiring and Marking.

3.17.1 Assembly.- Assembly of all units shall be in a permanent manner with the components accessible for servicing, replacement, or repairs. Bolts used in assembling units shall be equipped with captive nuts; bolts shall be of sufficient length so that at least three full threads will show over the nut after tightening. Lock washers of the internal tooth type 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.

3.17.2 Wiring.- Connecting wires shall be copper and shall have the proper insulation rating and be of adequate AWG size for the application, as specified in National Electric Code Article 310. 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, with the bundles secured by flame-retardant lacing or wiring clips and properly trained and supported to avoid strain on the connections. Wire bends with short radii shall be taken to avoid nicking or cutting the conductors.

3.17.3 Marking.- All equipment 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. 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, as well as the terminal blocks, shall be clearly identified. The identification shall correspond to the circuit and terminal designations as shown on the interconnection wiring diagram and on applicable diagrams contained in the instruction book.

3.18 Workmanship.- Workmanship shall be in accordance with MIL-HDBK-454, Requirement 9.

3.19 Monitored Points and Controls.- Test points shall be provided on all signals that are required to be monitored during checkouts, alignment, and calibration, or during preventive maintenance procedures. Test points shall not be located in compartments with voltage points of 500 volts or more, and all test points shall be located so as to preclude accidental shock to personnel engaged in normal operating or maintenance activities. The removal of components, modules, or circuit cards shall not be required to gain access to test points or adjustments. Test point controls and indicators mounted on printed wiring boards shall be accessible from the front of the circuit cage assembly without the use of extender boards.

3.20 Maintainability

3.20.1 Maintainability Design Criteria.- The following maintenance parameters must be met by the system :

- (a) Mean time to repair (MTTR) - The PAPI system shall have a MTTR of not more than 30 minutes and 99% of all repair times shall be less than two (2) hours. The contractor will demonstrate conformance of this requirement by performing maintainability analysis by using MIL-HDBK-472 as guidance.
- (b) Mean periodic maintenance time (MPMT) - The PAPI system MPMT shall be not greater than 2 hours per 3 months, including routine inspection.

3.21 Reliability Design Criteria.

3.21.1 System Reliability Parameters.- The following reliability parameter must be incorporated into the system:

- (a) Mean time between failures (MTBF) of the system, except for the lamps shall be not less than 2,500 hours. A system failure occurs when any component in the system prevents the system from meeting any requirement detailed in this specification.
- (b) The contractor shall demonstrate conformance with the above requirements by performing a reliability analysis using data and techniques in accordance with MIL-HDBK-217F and MIL-HDBK-781. If the periodic maintenance replaces component (s) prior to their failure, this may be included in the analysis.

4 VERIFICATION

4.1 VRTM. Appendix A contains the Verification of Requirements Traceability Matrix (VRTM) for the PAPI. Methods utilized to accomplish verification include:

- a. Analysis. An element of verification that utilizes established technical or mathematical models or simulations, algorithms, charts, graphs, circuit diagrams, or other scientific principles and procedures to provide evidence that stated requirements were met.
- b. Demonstration. An element of verification which generally denotes the actual operation, adjustment, or re-configuration of items to provide evidence that the designed functions were accomplished under specific scenarios. The items may be instrumented and quantitative limits of performance monitored.
- c. Inspection. An element of verification consisting of investigation, without the use of special laboratory appliances or procedures, of items to determine conformance to those specified requirements which can be determined by such investigations. Inspection is generally nondestructive and typically includes the use of sight, hearing, smell, touch, and taste; simple physical manipulation; mechanical and electrical gauging and measurement; and other forms of investigation.
- d. Test. An element of verification which generally denotes the determination, by technical means, of the properties or elements of items, including functional operation, and involves the application of established scientific principles and procedures.

4.2 Reserved

4.3 Reserved

4.4 Test Methods.- Testing of the equipment shall be performed as follows.

4.4.1 Design qualification test.- The first unit of production of each component is designated as the production model. Where the complement of a system and the prescribed manner of testing require the initial production of a group of identical units; for example, four lamp housing assemblies, and a power and control assembly, then all members of that group will be referred to hereinafter as part of the production model. The PAPI production model shall be subjected to the tests specified in 4.5, as required by Table VI. The production model and production units of the LHA shall contain 6.4A to 6.6A, 1000 hour lamps while undergoing testing. Any deformation, discoloration, deterioration, malfunction, or operation of the equipment outside of the prescribed conditions or limits of (3) during or after the conduct of each test shall be cause for rejection.

4.4.2 Production Unit Tests.- Testing of the production units shall start after acceptance of the production model. Tests on production units shall be as specified in 4.5, as required by table V.

4.4.3 PAPI Requirements Testing Discussion. – The relationship amongst Section 3 requirements, Table V, and Appendix A, is as follows:

- (a) Section 3 of this specification lists the functional and performance requirements that the equipment must comply with.
- (b) Table V (of Section 4) specifies that applicability of procedures defined in section 4.5 to the Qualification, Production, and Type Tests phases for the PCA, LHA, and Clinometer assemblies.
- (c) The Verification of Requirements Traceability Matrix (VRTM) in Appendix A stipulates the method of verification (test, analysis, inspection, demonstration) for each “shall” requirement in section 3 of the specification.

4.4.4 Type Tests - Tests are performed on regular production equipment or systems in accordance with the requirements in FAA-G-2100.

Table V. Qualification and Production Tests (Tables I-IV not used)

Test	Power and Control Assembly	Lamp Housing Assembly	Clinometer
Visual inspection (4.5.1)	X*	X*	X
Altitude (4.5.2)	X	X	-
Temperature (4.5.3)	Xt	Xt	X
Sand and dust (4.5.4)	X	X	-
Salt spray (4.5.5)	X	X	-
Rain (4.5.6)	X	X	-
Humidity (4.5.7)	Xt	Xt	X
Thermal shock (4.5.8)	X	X	-
Solar radiation (4.5.9)	X	X	-

Vibration (4.5.10)	Xt	Xt	-
Transient suppression (4.5.11)	X	-	-
Electromagnetic interference (4.5.12)	X	-	-
Power and control assembly performance (4.5.13)	X	-	-
1000-hour (4.5.14)	X	X	-
Two-hour (4.5.15)	*	*	-
Lampout operation (4.5.16)	-	X*	-
Shorting device test (4.5.16)		X	
Photometric (production Model) (4.5.17)	-	X	-
Photometric (production Unit) (4.5.18)	-	*t	-
Dielectric (4.5.19)	X	X	-
Lamp housing aiming (4.5.21)	-	X	-

-
- X - Design qualification tests (production model).
 - * - Production unit tests.
 - t - Type Test

4.5 Test Procedures.- Unless otherwise specified, the PAPI system shall be continuously energized and connected as shown in figure 6. The PAPI system shall be tested in

accordance with the tests specified herein and the failure criteria of paragraph 5.14 of MIL-STD-810F. The production model of the power and control assembly and one production model of the lamp housing assembly may be used during the conduct of the tests specified in 4.5.2 through 4.5.10. In addition, the production model shall undergo tests described in 4.5.13 and 4.5.18 at the conclusion of each test described in 4.5.3 through 4.5.11.

4.5.1 Visual Inspection.- The equipment shall be visually inspected for workmanship, fabrication, finishing, painting, and adequacy of selected parts.

4.5.2 Altitude Test.- The altitude test shall be in accordance with Procedures I and II, Method 500.4, of MIL-STD-810F. The equipment shall be tested at atmospheric pressures corresponding to sea level and 10,000 feet (3,048 meters) altitude at both -55°C (-67°F) and $+65^{\circ}\text{C}$ ($+149^{\circ}\text{F}$).

4.5.3 Temperature Test.- The high temperature test shall be in accordance with Procedure II, Method 501.4 of MIL-STD-810F, except that the temperature shall be $+65^{\circ}\text{C}$ ($+149^{\circ}\text{F}$). The low temperature test shall be in accordance with procedures I and II, Method 502.4, of MIL-STD-810F, except that the temperature shall be -55°C (-67°F). The 2-hour operational test (4.5.15) will start 2 hours after temperature stabilization. Procedure I and II shall be performed three times for low temperature. The equipment shall be aligned at the beginning of this test; the high and low temperature tests shall be completed without any further alignment or adjustment. The clinometer's performance requirements of 3.7.1 shall be verified over its entire operating range using the test methods described above.

4.5.4 Sand and Dust Test.- The sand and dust test shall be in accordance with Procedure I, Method 510.4, of MIL-STD-810F; rotate the equipment 120° twice. Air velocity shall be $2,500 \pm 500$ feet (760 ± 150 meters) per minute.

4.5.5 Salt Fog Test.- The salt fog test shall be in accordance with Procedure I, Method 509.4, of MIL-STD-810F for not less than 168 hours. Salt buildup as a result of the test may be removed with tap water.

4.5.6 Rain Test.- The rain test shall be in accordance with Procedure I, Method 506.4, of MIL-STD-810F.

4.5.7 Humidity Test.-The humidity test shall be in accordance with Method 507.4, of MIL-STD-810F, except that a total of three complete cycles (72 hours) will be required and the maximum temperature shall be $+65^{\circ}\text{C}$ ($+149^{\circ}\text{F}$). The base of the clinometer shall be rustproof such that the clinometer can meet all the performance requirements of 3.7.1 when subjected to the humidity test described above.

4.5.8 Thermal Shock Test.- The equipment shall be installed as in normal use and operated at maximum intensity until the temperatures have stabilized. At least 3 gallons (11.35 liters) of water at a temperature of 0° to $+5^{\circ}\text{C}$ (32° to $+41^{\circ}\text{F}$) shall be sprayed on the top surface. There shall be no cracking of glass or metal.

4.5.9 Solar Radiation (Sunshine) Test.- The test shall be conducted in accordance with Procedure I, Method 505.4, of MIL-STD-810F. The equipment shall be operated for 1 hour during the third cycle when the test item has reached its peak temperature.

4.5.10 Vibration Test.- The equipment shall be tested as described below.

- (a) Vibration planes. - The test assembly shall be vibrated in three planes or directions as follows:

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

Horizontally, parallel to the light beam axis.

Horizontally, at right angles to the light beam axis.

- (b) Frequencies.- The test assembly shall be vibrated through a frequency range of 10 to 2,000 cycles per second (cps) in each plane until the acceleration shown in Table VI are reached. Duration of each sweep shall be 10 minutes. A sweep shall be defined as the vibration of the test assembly through a frequency range as shown in Table VI.

Table VI. Vibration Test Data

Acceleration in G's	Frequency (CPS)
0.020 inch double amplitude (displacement)	10-70
3	70-200
3	200-500
3	500-2,000

Following the vibration test, the equipment 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.

4.5.11 Transient Suppression Test. - A surge generator shall be used to superimpose on the 120/240 VAC input power lines each of the applicable types of transients specified in 3.10 at least five times. Transient surges shall be applied between each input power line and the grounded neutral. The preset transient control levels shall be verified by open-circuit and short-circuit tests prior to applying each test surge to the unit. Test surges shall be superimposed while operating the PCA at current intensity settings of 4.5A and 6.4A respectively. The photosensing device shall be used to alternately switch the output current value before superimposing every other transient test surge. The time interval between successive superimposition of test surges shall be no more than 30 seconds. The equipment shall be continuously energized during the entire transient suppression test, which shall commence with the conduct of a performance test (4.5.13). Transient recovery time shall be tested using the production model lamp housing assembly lamp current as the measure of the 3-second recovery time requirement. The lamp current shall be within ± 2 percent of the current measured, in accordance with 4.5.13, at the commencement of the transient suppression test. This test will then be repeated between the LHA power lines and input power neutral, and then between the LHA signal lines and the input power neutral.

4.5.12 Electromagnetic Interference Test.- A production model of the power and control assembly shall be tested for conformance to the electromagnetic interference control requirements specified in 3.11. The power and control assembly shall be connected as shown in Figure 6. In addition, the power and control assembly shall be connected to a power source using no less than 300 feet (91.44 meters) of wire of sufficient size. The LHA lamps specified in paragraph 3.3.3 shall be installed in each lamp housing assembly during the conduct of the test. The electromagnetic interference measurement shall be in accordance with test methods CE1O2 and RE1O2 of MIL-STD-461E.

4.5.13 Power and Control Assembly Performance Test.- The power and control assembly shall be connected to a single phase, 60 Hz, 120/240V power source with neutral grounded in accordance with National Electric Code. The test load shall consist of a set of four LHAs.

The lamp load in each LHA shall consist of three 6.4A to 6.6A, 1000 hour lamps. The load current shall be adjusted to 6.4 ± 0.1 A rms by the current setting potentiometer with a nominal input voltage of 240 V. At the conclusion of the test, the lamp current for the series-connected lamps shall be within ± 2 percent of the nominal current setting, and the lamp current for the parallel-connected lamps shall be within ± 0.2 A of the nominal current setting. The input voltage shall be externally varied through the range of 216 V to 264 V. The load currents shall not deviate more than ± 2 percent of the nominal 6.4A setting when the input power is varied from 216 to 264V. Operation at the $4.5A \pm 0.1$ setting shall be adjusted and demonstrated as above and shall be within the ± 2 percent limitation. The photosensing device shall be electrically connected to the assembly. Operation, within the foot-candle limits set forth in 3.5.3.1.4 of this specification, shall be demonstrated using a certified light source with color temperature of 6500° Kelvin (K). In addition, the remote control input shall be used to turn the system on/off at least 100 times.

4.5.14 1000-Hour Operational Test.- The equipment shall be tested for 1000 continuous hours at an ambient temperature of $+30^\circ \pm 10^\circ\text{C}$ ($+86^\circ \pm 18^\circ\text{F}$). The current setting shall be varied so that the unit is at the low current level for 50% of each hour and at the high current level for 50% of each hour. The elapsed time indicator shall indicate the duration of operation at the high-intensity setting. The performance test described in 4.5.13 shall be conducted within 1 hour following the conclusion of the 1000-hour operational test. Prior to conducting the test, the PAPI control cabinet input and control voltages shall be measured and recorded. In addition, care shall be taken to ensure that the PAPI is fully operational (i.e., all lights and dummy loads are in good working condition. The time interval between cycles shall be at least 3 hours.

4.5.15 Two-hour Operational Test.- One cycle of the test described in 4.5.14 shall be performed, followed by the performance test described in 4.5.13, during a period of 2 continuous hours of operation.

4.5.16 Lampout Operational Test.- The LHAs shall be connected as shown in Figure 6 and shall be operated at 6.4A at an ambient temperature of $+30^\circ \pm 10^\circ\text{C}$ ($86^\circ \pm 18^\circ\text{F}$) to test the lampout circuitry as follows:

- (a) Remove one lamp in each LHA.
- (b) Turn on the system.
- (c) Verify that the remaining lamps are operating.
- (d) Using the PCA output current meter, verify that the two separate output currents are regulated to within ± 2 percent of the 6.4A setting.
- (e) Turn off the system.
- (f) Remove a second lamp in one LHA.
- (g) Turn on the system.
- (h) Verify that the lampout circuit turned off the PAPI system.

- (i) Replace the second lamp removed in step (f).
- (j) Repeat steps (f) through (h) until all lampout circuits have been tested and verified. The tests shall be performed at both 6.4A and 4.5A.
- (k) Repeat system turn on/off until one of the shorting devices has been activated 88 times without failure. Allow time for shorting device recovery between activations.

The shorting device shall be capable of performing a minimum of 88 operations without failure. The contractor shall measure the “make” voltage and current during a lampout operation and prove that the shorting device is capable of switching the “make” current without damage.

4.5.17 Production Model Photometric Test.- Four lamp housing assemblies, complete with quartz 6.4A to 6.6A 1000-hour lamps shall be energized at 6.4A, and each LHA shall be tested to verify compliance with the minimum photometric requirements of 3.4. The LHAs shall be mounted on the mounting base legs (3.3.9), leveled, and aimed at a surface target. The distance between the front face of the LHA and the light-measuring detector shall be 100 feet horizontally and vertically at 1° intervals.

4.5.18 Production Unit Photometric Test.- The light beam pattern of an LHA production model that meets the minimum photometric requirements of 3.4 shall be used to test the production units as follows: The production model shall be energized at 6.4A and its light beam shall be displayed on a vertical surface located 100 feet (30.5 m) from the front face of the LHA. The transition of the displayed light beam from red light to white light shall be marked on the vertical surface. Similarly, the production unit shall be energized at 6.4A and its light beam displayed on the vertical surface mentioned above. The transition from red light to white light of the production unit light beam shall remain within ± 1/4 inch (0.6 cm) of the markings on the vertical surface.

4.5.19 Dielectric Test.- A dielectric test shall be performed on all power and control leads of the production models. The test shall be performed using 60Hz ac voltage applied for 1 minute between insulated leads and ground.

All power wiring	1.5 kilovolts (kV) peak
All control parts, components, and wiring	0.5 kilovolt (kV) peak

4.5.20 Clinometer Test.- The accuracy of the clinometer shall be verified at an independent certified laboratory, and results of the test shall be submitted to the FAA for approval.

4.5.21 Lamp Housing Assembly Aiming Test.- The lamp housing assembly shall be aimed to a setting of 0.00° ±1 minute by use of a transit. The transit shall be located 100 ±1 feet (30.48 ±0.3 meters) in front of the lamp housing assembly and aligned in a horizontal plane with the LHA optical centerline. Following the alignment, the LHA shall be aimed to an angle of 2.00° using the calibrated production model clinometer, and its angular setting shall be verified by use of the transit. The transit shall show a setting of 2.00° ±2 minutes. The

procedure shall be repeated in strict sequence for aiming angles of 5.00°, 3.00°, 6.00° and 2.00°. Aiming angle repeatability at 2.00° shall be within ± 3 minutes of arc.

4.6 Test Performance.- All tests described above shall be performed at the contractor's expense at the contractor's facility or at an FAA approved independent testing laboratory. All tests shall be witnessed by an FAA representative. Tests shall be conducted on the production model and on production units as outlined above to provide compliance with this specification.

5. PACKAGING

Packaging requirements shall be as specified in the contract or order (see paragraph 6.2 of MIL-STD-961D/1).

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

6.1 Cross-reference with NAS-SS-1000. Appendix B contains traceability with NAS-SS-1000 Requirements.

6.2 Mounting hardware not furnished under this contract. The aluminum flanges shall be designed for installation on a concrete pad and shall have a threaded boss to receive the frangible coupling. The adjusting hardware shall be designed to prevent any displacement of the optical system due to vibration. Frangible couplings, emt, and aluminum flanges are not furnished under this specification.

APPENDIX A. Verification of Requirements Traceability Matrix (VRTM)

#	SEC#	HEADING	DESCRIPTION	DQT	OT&E	SEC. IV	Type Test
1	3.1	General functional requirements	The PAPI system shall meet the requirements specified herein, and shall consist of: (a) Four LHA, with integral mounting and adjustment hardware (3.3). (b) One Power and control assembly (3.5). (c) One Aiming instrument set (3.7).	I	I		
2	3.3	Lamp housing assembly	The lamp housing assembly (LHA) shall consist of: (A) & (B)	I	I		
3	3.3	“	The optical bench shall be integral with the aluminum...	I	I		
4	3.3	“	A transverse leveling pad and aiming pad compatible with clinometer specified in section 3.7.1 shall be integral part of optical bench	I	I		
5	3.3	“	The deflection plate is to prevent the pilot from seeing light reflected off the back of the PAPI and shall have a minimum height of 7% of the length of the housing shell (adequate protection up to 4 degrees above flight path).	I	I		
6	3.3	“	The LHA shall be designed to maintain the required light beam orientation and photometric requirements under the environmental conditions specified in 3.9.	T	T	4.5.17	
7	3.3.1	Optical bench	The optical bench shall be constructed of non-corrosive metal and shall be of sufficient thickness, in conjunction with the structural design, to provide rigidity.	A	I		
8	3.3.2	Housing shell	The optical bench shall be enclosed by housing shell made of non-corrosive metal.	I	I		
9	3.3.2	“	The thickness of the housing shell material, in conjunction with the structural design, shall meet the requirements of 3.9.9.	A	I		
10	3.3.2	“	The maximum dimension of any drain hole shall be not greater than ¼ inch (6.35 millimeters (mm)) to prevent intrusion of foreign objects.	I	I		
11	3.3.2	“	Removal of the housing shall permit easy access to the lamps, filter-lens assemblies, and electrical components mounted on the optical bench.	D	D		
12	3.3.2	“	The housing shell shall be installed on a mounting base of sufficient rigidity to maintain the requirements of 3.4.4 over the expected life of the product, (see figures 3 and 4).	I	I		
13	3.3.2	“	It shall be secured by means of fasteners to discourage unauthorized persons from tampering with the equipment.	I	I		
14	3.3.3	“	The Lamp shall have rated life of 1000 hours when operated in the LHA on the high intensity setting.	D	D		
15	3.3.3	“	The lamps shall be quartz-halogen 6.4A to 6.6A lamps.	A	I		
16	3.3.3	“	The lamp leads shall be No. 16 American Wire	T	T	4.5.19	

			Gauge (AWG) (minimum) insulated copper conductors.				
17	3.3.3	Lamp and Lamp Mounting	The lamp mounting shall permit firm and positive positioning of the three lamps.	<u>D</u>	<u>D</u>		
18	3.3.3	“	The lamp mounting shall be designed to facilitate lamp removal and replacement to meet the required Mean Time To Repair (MTTR) stated in section 3.20.1 (a).	<u>D</u>	<u>D</u>		
19	3.3.4	Filter assembly	Three red, glass filter assemblies shall be supplied with each lamp housing assembly.	<u>I</u>	<u>I</u>		
20	3.3.4	“	The filters shall have a transmittance of at least 15 percent when the lamps are operated at full intensity.	<u>A</u>	<u>I</u>		
21	3.3.4	“	The filters and retaining hardware shall be positively keyed to ensure correct mounting in relation to the lamps.	<u>D</u>	<u>D</u>		
22	3.3.4	“	The filter assemblies shall be easily removable for replacement purposes.	<u>D</u>	<u>D</u>		
23	3.3.5	Projection Lens	The glass projection lenses shall be mounted in a vertical cast aluminum or stainless steel frame that will prevent any stray light from entering the LHA (figure 4).	<u>I</u>	<u>I</u>		
24	3.3.5	“	The lenses shall be recessed under an overhang to minimize the direct impingement or splash-back of rain or snow on the lenses.	<u>I</u>	<u>I</u>		
25	3.3.5	“	The overhang shall protrude beyond the front of the unit by a distance equal to or greater than the height of the housing shell.	<u>I</u>	<u>I</u>		
26	3.3.6	Terminal block	A terminal block shall be provided in the rear of the lamp housing assembly.	<u>I</u>	<u>I</u>		
27	3.3.6	“	The terminal block shall provide non-corroding type terminals rated to carry 10 amperes (A) at 250 volts alternating current (V ac).	<u>A</u>	<u>I</u>		
28	3.3.6	“	Electrical contact surfaces of terminals shall be brass, bronze or copper that satisfy UL 1059 standard .	<u>I</u>	<u>I</u>		
29	3.3.6	“	Pressure screws shall be brass, bronze or stainless steel that satisfy UL 1059 standard .	<u>I</u>	<u>I</u>		
30	3.3.6	“	The terminal block shall have sufficient terminals to accommodate all internal connections, plus connection of external power cables.	<u>I</u>	<u>I</u>		
31	3.3.7	Power input cable entrance connector	Space shall be reserved in the rear of the lamp housing assembly to permit connection of the incoming power cable to the terminal block.	<u>I</u>	<u>I</u>		
32	3.3.7	“	The cable shall enter through one hole located in the bottom rear of the housing.	<u>I</u>	<u>I</u>		
33	3.3.7	“	The hole shall be provided with a cable strain relief connector, firmly secured to the housing, and shall be designed to firmly secure a cable having a diameter of 0.3 to 0.5 inches (7.62 to 12.7 mm).	<u>I</u>	<u>I</u>		
34	3.3.7	“	The strain relief connector shall have a neoprene grommet to provide a compressive surface on the cable.	<u>I</u>	<u>I</u>		
35	3.3.8	Weight	The weight of the lamp housing assembly, excluding lamps and mounting legs, shall be not greater than 100 pounds (45 kilograms (kg)).	<u>A</u>	<u>I</u>		

36	3.3.9	Mounting Provisions	The lamp housing assembly shall be installed on the rigid mounting base as shown in figures 3 and 4.	<u>I</u>	<u>I</u>		
37	3.3.9	“	The mounting base shall have three adjustable legs to permit aiming of the light beam to any vertical angle from 1.5° up to 6°.	<u>A</u>	<u>I</u>		
38	3.3.9	“	Also, the mounting and adjustment hardware shall permit transverse leveling where any mounting leg may be up to 1 inch (2.54 cm) higher or lower than any other leg after installation	<u>I</u>	<u>I</u>		
39	3.3.9	“	The legs shall consist of mounting and adjusting hardware, 2-inch electrical metallic tubing (emt), frangible couplings conforming to FAA Drawing C-6046, and aluminum flanges.	<u>I</u>	<u>I</u>		
40	3.3.10	Lampout Feature	If series-connected lamps are used in the system, switching devices shall be provided in the lamp housing assembly to automatically maintain circuit continuity when a lamp(s) fails, and to ensure continued operation of the remaining series-connected lamps.	<u>D</u>	<u>D</u>		
41	3.3.11	Housing shell finish	All aluminum exterior and interior surfaces of the lamp housing shell shall be pretreated with a chemical film in accordance with MIL-C-5541E, Class 1A, and shall be sprayed with one coat of zinc chromate primer in accordance with Federal Specification No. TT-P-1757, composition L, color Y.	<u>A</u>	<u>I</u>		
42	3.3.11.1	Interior finish	The deflection plate and all interior surfaces of the aluminum housing shell, including the interior surface of the overhang, shall be painted with not less than a body coat and a finish coat of alkyd enamel in accordance with Master Painters Institute reference #49, Black, color No. 37038 of FED-STD-595.	<u>A</u>	<u>I</u>		
43	3.3.11.1	Interior finish	The paint shall be applied to at least 2.5 mils (63.5 microns) thickness and the final painted surfaces shall be free of blotches, scratches, and runs.	<u>I</u>	<u>I</u>		
44	3.3.11.2	Exterior finish	All exterior surfaces of the housing shell, shall be painted with not less than a body coat and two finish coats of alkyd baking enamel in accordance with QPL-TT-E-489-48, MPI # 48 Class B, International Orange, Color No. 12197 of FED-STD-595.	<u>A</u>	<u>I</u>		
45	3.3.11.2	Exterior finish	The paint shall be applied to at least 3.0 mil (76.2 microns) thickness and the final painted surfaces shall be free of blotches, scratches, and runs.	<u>I</u>	<u>I</u>		
46	3.3.12	Optical bench finish	The optical bench including the lamps and projector mounting frames shall be painted as described in 3.3.11.1.	<u>I</u>	<u>I</u>		
47	3.3.13	Mounting base finish	The LHA mounting base shall be painted as described in 3.3.11.1.	<u>I</u>	<u>I</u>		
48	3.3.14	Tilt Switch	Each lamp housing assembly unit shall have a tilt switch in the unit.	<u>I</u>	<u>I</u>		
49	3.3.14	“	The tilt switch system shall de-energize the	<u>T</u>	<u>T</u>		

			lamps when the optical pattern is lowered between 1/4 and 1/2 degree or raised between 1/2 and 1 degree with respect to the preset aiming angle.				
50	3.3.14	“	The tilt switch shall have a time delay of at least 10 seconds that will prevent intermittent tilt switch activation due to vibration.	<u>T</u>	<u>T</u>		
51	3.3.14	“	The tilt switch shall have fail-safe operation so that any malfunction of the tilt switch, including loss of input power, shall de-energize the lamp circuit in all indicators.	<u>T</u>	<u>T</u>		
52	3.4.1	Light beam	The LHAs shall provide a split beam of light consisting of white light in the top sector and red light in the bottom sector as viewed from the front.	<u>T</u>	<u>T</u>	<u>4.5.18</u>	
53	3.4.1	“	The transition from red light to white light shall occur within an angle of 3 minutes of arc at the beam center and within an angle of 5 minutes of arc at the beam edges.	<u>T</u>	<u>T</u>	<u>4.5.18</u>	
54	3.4.1	“	The transition band shall be flat to within 3 minutes of arc.	<u>T</u>	<u>T</u>	<u>4.5.18</u>	
55	3.4.1	“	The PAPI shall provide usable visual approach guidance out to at least ±10 degrees either side of the extended runway centerline.	<u>D</u>	<u>I</u>		
56	3.4.2	Light intensity	Each LHA shall contain three lamps.	<u>I</u>	<u>I</u>		
57	3.4.2	“	Each LHA shall meet the minimum intensity requirements, as shown in figure 5, while operating at 6.4 A root means square (rms) (high intensity).	<u>T</u>	<u>T</u>	<u>4.5.18</u>	Type Test
58	3.4.2	“	The method of controlling the lamp intensity shall not decrease the lamp manufacturers 1000-hour sinusoidal waveform life expectancy for the lamps.	<u>I</u>	<u>I</u>		
59	3.4.3	Light colors	The light colors shall be aviation white and aviation red as defined in SAE-AS25050, Colors, Aeronautical Lights and Lighting Equipment, General Requirements for, paragraph 3.1, Aviation Colors.	<u>I</u>	<u>I</u>	<u>4.5.18</u>	
60	3.4.4	Light beam aiming tolerance	The centerline of the transition zone (i.e. the vertical area of change from red light to white light) of each LHA projected light signal shall be parallel to the zero aiming angle projection within plus or minus five (5) minutes of arc.	<u>T</u>	<u>T</u>	<u>4.5.18</u>	
61	3.5	Power and control assembly					
62	3.5.1	General	The power and control assembly shall control the supply of 4.5A rms (low intensity) or 6.4A rms (high intensity) service to the lamps (Figure 6).	<u>T</u>	<u>T</u>	<u>4.5.13</u>	
63	3.5.1	“	The power and control assembly shall form one compact, light weight, self-cooled unit that will be installed adjacent to the LHA furthest from the runway.	<u>I</u>	<u>I</u>		
64	3.5.1	“	The weight of the power and control assembly shall not exceed 50 pounds (22.67 kg).	<u>D</u>	<u>I</u>		

65	3.5.2	Operational requirements	The power and control assembly shall supply power for operation of the PAPI system at two light intensity steps as follows: 95 to 100 percent (6.4A rms) for daytime operation and approximately 8.5 percent (4.5A rms) for night operation.	<u>T</u>	<u>T</u>	<u>4.5.13</u>	
66	3.5.2	“	The intensity of the lights shall be controlled by the photoelectric switching circuitry (3.5.3.1.4).	<u>T</u>	<u>T</u>	<u>4.5.13</u>	
67	3.5.2	“	The ON/OFF operation of the PAPI system will be controlled by the remote control input signal (120 VAC, 60Hz).	<u>T</u>	<u>T</u>	<u>4.5.13</u>	
68	3.5.2	“	The 120/240 volt, 60Hz input power lines (with neutral grounded in accordance with National Electric Code) shall terminate at the input terminal block (3.5.3.1.1), and shall be connected to internal circuitry of the power and control assembly through a 2-pole main circuit breaker (3.5.3.1.2).	<u>I</u>	<u>I</u>		
69	3.5.2	“	The power and control assembly shall provide two separate, constant, root mean square output currents (of 6.4 A or 4.5A) to each of two respective, two-wire output circuits, as determined by the photoelectric switching circuitry.	<u>A</u>	<u>I</u>	<u>4.5.13</u>	
70	3.5.2	“	The crest factor of the output voltage waveform shall be no greater than 1.1 and the voltage distortion relative to a sine wave shall be not greater than 10 percent of Total Harmonic Distortion Voltage (THDV).	<u>T</u>	<u>T</u>		
71	3.5.2	“	The system shall recover automatically from momentary power interruptions.	<u>D</u>	<u>D</u>		
72	3.5.3	Power and control assembly cabinet	The power and control assembly cabinet shall contain all power and control components (3.5.3.1), including terminal blocks, cable clamps, grounding lugs, and protective devices.	<u>I</u>	<u>I</u>		
73	“	“	The cabinet shall be an outdoor, liquid-tight, aluminum National Electrical Manufacturers Association (NEMA-4X) type enclosure of sufficient size.	<u>I</u>	<u>I</u>		
74	“	“	All plane surfaces of the control cabinet shall intersect at 90°.	<u>I</u>	<u>I</u>		
75	“	“	If used, the thyristors shall be mounted within the enclosures and adequate heat sinks shall be provided.	<u>A</u>	<u>I</u>		
76	“	“	Proper high-temperature wire in accordance with National Electric Code Article 310 (see Tables 310-13 and 310-61). shall be used throughout the cabinet.	<u>A</u>	<u>I</u>		
77	“	“	Sufficient wiring space shall be provided in the bottom of the cabinet for all wiring (input, output, and internal) and for all terminal blocks.	<u>I</u>	<u>I</u>		
78	“	“	Access to the interior of the cabinet shall be provided through one hinged and gasketed door, equipped with a three point latch set with provision for padlocking.	<u>I</u>	<u>I</u>		

79	“	“	The padlock hasp shall have a 7/16 inch (11.1 mm) hole. (Padlocks are not furnished under this specification).	<u>I</u>	<u>I</u>		
80	“	“	The door shall open a minimum of 110° and shall be equipped with a mechanism to ensure the door remains open and can withstand winds of 100MPH.	<u>D</u>	<u>I</u>		
81	“	“	The internal face portion of the door shall be provided with a pocket to hold a wiring diagram (3.17.3).	<u>I</u>	<u>I</u>		
82	“	“	The door of the cabinet shall be bonded to the body of the cabinet in accordance with National Electric Code (NEC) Article 250-90 (2002).	<u>I</u>	<u>I</u>		
83	“	“	An internal ground lug shall be provided in the cabinet for grounding purposes.	<u>I</u>	<u>I</u>		
84	“	“	The ground lug shall have a slotted, green-colored head suitable for a No. 6 American Wire Gauge bare copper ground wire.	<u>I</u>	<u>I</u>		
85	“	“	Electronic components shall be mounted on plug-in printed wiring boards whenever practicable	<u>I</u>	<u>I</u>		
86	“	“	All adjustments located on printed wiring boards shall be readily accessible to the operator.	<u>I</u>	<u>I</u>		
87	“	“	Adjustments shall be made without the need to use extender card or cable.	<u>D</u>	<u>I</u>		
88	3.5.3.1	Components					
89	3.5.3.1.1	Terminal blocks	One input/output terminal block of the enclosed base type, with screw-pressure terminal, shall be provided.	<u>I</u>	<u>I</u>		
90	“	“	The three input positions shall be suitable for No. 4 AWG through No. 8 AWG standard conductors.	<u>I</u>	<u>I</u>		
91	“	“	Signal wiring from the LHA to the PCA shall be No.18 AWG or No.20 AWG	<u>I</u>	<u>I</u>		
92	“	“	Each pressure-type terminal shall be equipped with a pressure plate to prevent the tip of the screw from turning directly on the wire.	<u>I</u>	<u>I</u>		
93	“	“	Separators are required between the terminals; the separators shall be integrally molded with the base material.	<u>I</u>	<u>I</u>		
94	“	“	The separators shall be of adequate design to prevent current leakage due to humidity.	<u>D</u>	<u>I</u>		
95	“	“	Marking shall be provided in accordance with 3.17.3.	<u>I</u>	<u>I</u>		
96	3.5.3.1.2	Circuit breaker	A properly rated two-pole, molded-case, Thermal magnetic circuit breaker or electronic solid state type shall be provided as a main circuit breaker and power switch.	<u>A</u>	<u>I</u>		
97	“	“	The circuit breaker shall have an arc quenching chamber and shall have a minimum rating of Asymmetrical interrupting capacity (AIC) of 10,000A(10KA) at 250V, 60Hz.	<u>A</u>	<u>I</u>		
98	3.5.3.1.3	Thyristors	Thyristors, If used, shall have a minimum peak repetitive off-state voltage (V_{DRM})	<u>A</u>	<u>I</u>		

			rating of 600 V and a minimum rms on-state current (I_T) rating of 25A.				
99	“	“	Thyristors shall have suitable heatsinks to ensure operation within the thermal constraints of the particular device selected.	<u>I</u>	<u>I</u>		
100	“	“	The thyristors selected shall not be damaged by the currents or voltages encountered when one or more lamps fails.	<u>T</u>	<u>T</u>	<u>4.5.16</u>	
101	3.5.3.1.4	Photoelectric switching circuitry	A photoelectric switching circuitry shall be provided to change automatically the intensity of the lights in two steps as described below.	<u>T</u>	<u>T</u>	<u>4.5.13</u>	
102	“	“	All operating components of the switching circuitry, except the photosensing device (3.5.3.1.5) and any associated signal conditioning circuitry, shall be mounted on a printed wiring board mounted within the cabinet.	<u>I</u>	<u>I</u>		
103	“	“	The photoelectric switching circuitry shall set the output current to 6.4A rms when the illumination on a vertical surface facing north reaches 58 ± 2 foot-candles (624 ± 21.5 lux), and shall set the output current to 4.5A rms when the illumination falls to 35 ± 2 foot-candles (377 ± 21.5 lux).	<u>T</u>	<u>T</u>	<u>4.5.13</u>	
104	“	“	The on-off points shall vary not greater than ± 2 foot-candles (± 21.5 lux), at any ambient temperature ranging from -55° Centigrade (C) (-67° Fahrenheit (F)) to $+70^\circ$ C ($+158^\circ$ F) with line voltage variations from 115 V to 125 V.	<u>T</u>	<u>T</u>	<u>4.5.13</u>	
105	“	“	Similarly, the on-off points shall vary not greater than 3 foot-candles (32.28 lux) with line voltage variations from 108 V to 115 V and from 125 V to 132 V.	<u>T</u>	<u>T</u>	<u>4.5.13</u>	
106	“	“	A symmetrical time delay of 5 to 8 seconds shall be provided to prevent the output current from changing due to transient light conditions.	<u>T</u>	<u>T</u>	<u>4.5.13</u>	
107	“	“	A fail-safe feature shall set the output current to 4.5 A in the event the photosensing device fails	<u>T</u>	<u>T</u>	<u>4.5.13</u>	
108	3.5.3.1.5	Photosensing device	The photosensing device shall be mounted on the top surface of the PCA cabinet and shall be able to rotate and to lock in position	<u>I</u>	<u>I</u>		
109	“	“	The device shall be hermetically sealed, and shall have a spectral response which peaks in the 5500 - 6000 angstroms (0.021 - 0.023 mil) region.	<u>T</u>	<u>T</u>		
110	“	“	The device shall meet the temperature requirements of the photoelectric switching circuitry (3.5.3.1.4)	<u>I</u>	<u>I</u>		
111	“	“	The device shall activate the photoelectric switching circuitry (3.5.3.1.4).	<u>T</u>	<u>T</u>	<u>4.5.13</u>	
112	3.5.3.1.6	Current control device	A load current-sensing control device shall be provided to vary automatically the conduction of the thyristors in order to	<u>T</u>	<u>T</u>		

			maintain a constant rms load current through the lamps of the lamp housing assemblies.				
113	“	“	All operating components shall be mounted on plug-in printed wiring boards, whenever practicable.	<u>I</u>	<u>I</u>		
114	“	“	The boards shall be mounted within the cabinet.	<u>I</u>	<u>I</u>		
115	“	“	Potentiometers shall be provided for setting the load currents.	<u>D</u>	<u>I</u>		
116	“	“	One potentiometer shall be provided for adjusting the 6.4A current and a separate, independent potentiometer shall be provided for setting the 4.5A current.	<u>I</u>	<u>I</u>		
117	“	“	The potentiometers shall have a control range to accommodate a ± 10 percent minimum variation in load.	<u>I</u>	<u>I</u>		
118	“	“	Each thyristor shall have a separate current control device.	<u>I</u>	<u>I</u>		
119	“	“	Monitor points shall be provided to monitor the output current, and shall drive the true rms output current indicating meter (3.5.3.1.9).	<u>D</u>			
120	“	“	The output of the monitor device shall be scaled to read equivalent rms current with a high input impedance (1 megohm minimum) digital voltohmmeter (vom) when adjusting the current control potentiometer.	<u>I</u>	<u>I</u>		
121	“	“	The current control device shall regulate the true rms values of each level of the two separate output currents to within ± 4 percent under the following conditions: (a) for any combination of the environmental conditions set forth in 3.9, (b) for power line input voltage variation between 216 V and 264 V and the transient recovery requirements of 3.10, and (c) when two lamps fail or when two lamps are removed from a loop.	<u>T</u>	<u>T</u>		
122	“	“	The current control device shall limit the maximum rms value of the output current to no more than ± 10 percent of the nominal load current of 6.4 A rms, regardless of the output current and voltage waveform, input current and voltage transients, and +10 percent variation from nominal input voltage.	<u>T</u>	<u>T</u>		
123	“	“	An overcurrent protection feature shall be incorporated into the design of the current control device.	<u>T</u>	<u>T</u>		
124	3.5.3.1.7	Elapsed time indicator	An elapsed time indicator shall be provided to register the number of hours of operation during the high-intensity setting.	<u>I</u>	<u>I</u>		
125	“	“	The meter shall operate on 120 V, 60 Hz power and shall indicate total time in hours and 10ths of hours.	<u>I</u>	<u>I</u>		
126	“	“	The meter shall be recyclable and shall have a minimum indicator range of 9,999.9 hours.	<u>I</u>	<u>I</u>		
127	“	“	The meter shall be mounted within the cabinet.	<u>I</u>	<u>I</u>		
128	3.5.3.1.8	Power supply	A power supply shall be provided to supply	<u>T</u>	<u>D</u>	<u>4.5.13</u>	

			the proper voltages and currents necessary to operate the power and control assembly circuits within the tolerances and conditions set forth in this specification.				
129	“	“	Wherever practicable, all electronic components shall be mounted on a plug-in printed wiring board mounted within the cabinet.	<u>I</u>	<u>I</u>		
130	3.5.3.1.9	RMS output current meter	One panel-mounted true rms indicating meter with calibration marks at 6.4A and 4.5A shall be provided for the series-connected lamps.	<u>I</u>	<u>I</u>		
131	3.5.3.1.9	“	There shall be a provision to calibrate the meter.	<u>D</u>			
132	“	“	The 6.4A indication shall be in the upper 60 percent of the meter scale.	<u>I</u>	<u>I</u>		
133	“	“	The meter shall have an accuracy of ± 2 percent of reading.	<u>A</u>			
134	“	“	The meter scale from zero to full scale shall be 120° with 0.1 A markings that will be highlighted by a reflective mirror.	<u>I</u>	<u>I</u>		
135	“	“	The rms output current meter shall indicate the output current from the power and control assembly.	<u>I</u>	<u>I</u>		
136	“	“	A three position switch shall be provided that will switch the meter to either one of the two output circuits or to the off position.	<u>D</u>	<u>I</u>		
137	3.5.4	Power and control assembly finish	All aluminum exterior and interior surfaces of the power and control assembly shall be pretreated with a chemical film in accordance with MIL-C-5541, Class 1A.	<u>A</u>	<u>I</u>		
138	3.5.4	“	All aluminum exterior surfaces of the control cabinet shall be sprayed with one coat of zinc chromate primer in accordance with Federal Specification No. TT-P-1757, composition L, color Y.	<u>A</u>	<u>I</u>		
139	“	“	Following the application of the primer, the exterior surfaces of the control cabinet shall be painted with not less than a body coat and two finish coats of alkyd baking enamel (in accordance with QPL-TT-E-489-48 , MPI # 48, Aviation White, Color No. 17875 (in accordance with FED-STD-595).	<u>A</u>	<u>I</u>		
140	“	“	The paint shall be applied to at least 3.0 mil (76.2 microns) thickness and the final painted surfaces shall be free of blotches, scratches, and runs.	<u>A</u>	<u>I</u>		
141	“	“	The interior surfaces of the control cabinet shall be painted with not less than a body coat and two finish coats of alkyd baking enamel (in accordance with QPL-TT-E-489-48 or MPI #48 Aviation White, Color No. 17875 (in accordance with FED-STD-595).	<u>A</u>	<u>I</u>		
142	3.6	Interchangeability	All parts of the unit furnished under a single procurement shall be manufactured to a tolerance that shall permit interchangeability of any part with like part of any other unit.	<u>I</u>	<u>I</u>		
143	“	“	Identical components shall be identified with identical parts numbers and unlike parts shall	<u>A</u>	<u>I</u>		

			not have the same part number.				
144	“	“	. Interchangeability shall be in accordance with MIL-HDBK-454, Requirement 7.	<u>D</u>	<u>I</u>		
145	3.7.1	Clinometer	The clinometer shall be used to adjust accurately the LHA during cross-leveling (lateral), longitudinal leveling, and elevation setting.	<u>D</u>	<u>D</u>		
146	“	“	The base of the clinometer shall be rustproof.	<u>I</u>	<u>I</u>		
147	“	“	The clinometer shall be constructed of non-corrosive metal to provide a light-weight 10 lbs (4.5kg) maximum rugged instrument.	<u>I</u>	<u>I</u>		
148	“	“	Design and construction of the clinometer shall be such that deviation from true position due to its own weight shall be not greater than 3 minutes of arc when the clinometer is placed on the optical bench (3.3.1).	<u>D</u>	<u>D</u>		
149	“	“	An accurate direct-reading dial shall be provided for setting the LHA to the desired angle.	<u>I</u>	<u>I</u>		
150	“	“	The reading dial shall indicate angles from 1.5° to 6° in graduated increments of 0.10°.	<u>I</u>	<u>I</u>		
151	“	“	The spacing between each degree mark shall be at least 1/2 inch (12.7 mm).	<u>I</u>	<u>I</u>		
152	“	“	A 0.00° setting shall be provided on the dial for calibration purposes and shall have an accuracy of ±2 minutes of arc and a repeatability of ±1 minute of arc while on the calibration bar.	<u>D</u>	<u>I</u>		
153	“	“	The clinometer shall be designed so that repeated changing of the dial setting will not cause excessive wear that could deteriorate the accuracy of the instrument.	<u>D</u>	<u>D</u>		
154	“	“	Aluminum and other soft metals shall not be used where subject to metal-to-metal rubbing.	<u>I</u>	<u>I</u>		
155	“	“	The clinometer shall have provisions for firmly securing the dial setting after factory calibration, but shall permit field adjustment to the 0.00° position by the user.	<u>D</u>	<u>I</u>		
156	“	“	The clinometer shall utilize a 6-inch (15.24 cm) (maximum) level having an accuracy of ±2 minutes.	<u>D</u>	<u>I</u>		
157	“	“	The level shall be permanently attached to the clinometer to permit fine adjustments to calibrate the instrument.	<u>I</u>	<u>I</u>		
158	“	“	The level shall have a protective device to minimize possible damage.	<u>I</u>	<u>I</u>		
159	3.7.2	Calibration Bar	A calibration bar shall be provided with each clinometer to permit field checking and calibration.	<u>I</u>	<u>I</u>		
160	“	“	The calibration bar shall be designed for laying on a flat surface or in the carrying case (see 3.7.3) and shall have adjustment features to permit it being leveled to a horizontal plane.	<u>D</u>	<u>I</u>		
161	“	“	The tolerance for the flatness of the	<u>I</u>	<u>I</u>		

			calibration bar shall be $\leq .005''$.				
162	“	“	A portable level, not attached to the bar, shall be provided with each calibration bar to permit leveling.	<u>I</u>	<u>I</u>		
163	“	“	The level shall be the same type as used on the clinometer in 3.7.1, with a metal base meeting the requirements of paragraph 3.13.1.	<u>D</u>	<u>I</u>		
164	“	“	The level shall be used to verify the calibration of the clinometer.	<u>D</u>	<u>I</u>		
165	3.7.3	Carrying and storage case.	A rigid portable non-corrosive metal or fiberglass case shall be provided for carrying and storing the clinometer.	<u>I</u>	<u>I</u>		
166	“	“	The case shall have a carrying handle and shall have a suitable latch for securing the cover in the closed position.	<u>I</u>	<u>I</u>		
167	“	“	The interior shall be designed to accommodate the clinometer so that it will be held and cushioned firmly in place.	<u>I</u>	<u>I</u>		
168	3.7.3.1	Carrying and storage case finish.	All aluminum exterior and interior surfaces of the carrying and storage case shall be pretreated with a chemical film in accordance with MIL-C-5541, Class 1A.	<u>I</u>	<u>I</u>		
169	“	“	All aluminum exterior surfaces shall be sprayed with one coat of zinc chromate primer in accordance with Federal Specification No. TT-P-1757, composition L, color Y.	<u>I</u>	<u>I</u>		
170	“	“	Following the application of the primer, the exterior surfaces of the carrying case shall be painted with not less than a body coat and two finish coats of alkyd baking enamel in accordance with QPL-TT-E-489-48, MPI # 48, Class B, International Orange, Color No. 12197 of FED-STD-595.	<u>I</u>	<u>I</u>		
171	“	“	The paint shall be applied to at least 2.0 mil (76.2 microns) thickness and the final painted surfaces shall be free of blotches, scratches, and runs.	<u>I</u>	<u>I</u>		
172	3.9	Environmental requirements	The equipment shall be designed for outdoor installation and continuous or intermittent operation under the environmental conditions specified below.	<u>I</u>	<u>I</u>		
173	3.9.1	Temperature	The temperature range shall be from -55°C (-67°F) to +65°C (+149°F).	<u>T*</u>	<u>T</u>	<u>4.5.3</u>	<u>Type Test</u>
174	3.9.1	Temperature	The clinometer (para 3.7.1) shall meet all the performance requirements of 3.7.1 when operated over this temperature range.	<u>T</u>		<u>4.5.3</u>	
175	3.9.2	Altitude	The pressure altitude shall range from sea level to 10,000 feet (3,048 meters).	<u>T</u>		<u>4.5.2</u>	
176	3.9.3	Temperature Shock (Thermal Shock)	The system external surfaces (including projection lenses) shall be exposed to a sudden application of cold water at a temperature of 0° to +5 ° C when the lights reach stable operating temperatures at 20°C ambient temperature.	<u>T*</u>		<u>4.5.3</u>	Type Test
177	3.9.4	Humidity	Relative humidity shall be up to 100 percent, including conditions where condensation	<u>T*</u>		<u>4.5.7</u>	Type Test

			takes place in the form of both water and frost.				
178	3.9.5	Sand and Dust	The system shall be exposed to windblown sand and dust particles as may be encountered in arid regions.	<u>T</u>		<u>4.5.4</u>	
179	3.9.6	Rain	The system shall be exposed to windblown rain.	<u>T</u>		<u>4.5.6</u>	
180	3.9.7	Salt Spray	The system shall be exposed to salt-laden atmosphere with relative humidity as stated in 3.9.4.	<u>T</u>		<u>4.5.5</u>	
181	3.9.8	Solar radiation (sunshine)	The system shall be exposed to sunshine with ambient temperatures as stated in 3.9.1.	<u>T</u>		<u>4.5.9</u>	
182	3.9.9	Vibration	The LHAs and the PCA shall be capable of withstanding vibrations in the frequency range of 10 to 2,000 Hertz.	<u>T*</u>		<u>4.5.10</u>	Type Test
183	3.10	Transient suppression	The equipment shall be designed to suppress switching transients, and to withstand transient increases superimposed on the 120/240 V ac (rms) power line input voltage that reach a peak value of 500 V for as long as 50 milliseconds.	<u>T</u>		<u>4.5.11</u>	
184	“	“	In addition, the equipment shall be designed to withstand lightning transients superimposed on each input power line.	<u>T</u>		<u>4.5.11</u>	
185	“	“	These transients shall be characterized as 8 by 20 microseconds (wave form) current surges of 10,000 amperes with the subsequent power-follow currents and voltage surges of up to 10 kV/microsecond (minimum).	<u>T</u>		<u>4.5.11</u>	
186	“	“	The equipment shall recover and resume normal operation automatically within 3 seconds (transient recovery time) when an interruption or a shutdown is experienced due to a lightning transient.	<u>D</u>			
187	“	“	Equipment performance and operational functions shall not be degraded beyond the specification requirements by the above transients when each type of transient is superimposed a minimum of five times on each power input terminal while the equipment is energized.	<u>D</u>			
188	“	“	Transient suppression devices shall be provided for all power lines at their first point of interface with the equipment.	<u>I</u>			
189	“	“	The return for the lightning transient protection devices shall be connected to earth ground via a separate dedicated ground lug that will accommodate not less than a No. 6 AWG conductor.	<u>I</u>			
190	“	“	The transient protection for signal lines and the LHA power lines shall be in accordance with FAA-STD-019 Lighting and Surge Protection, Grounding, Bonding, and shielding Requirements for Facilities and Electronic Equipment	<u>I</u>	<u>I</u>		
191	3.11	Electromagnetic interference control	Conducted interference levels on incoming ac power leads, control leads, and signals leads	<u>T</u>		<u>4.5.12</u>	

			shall be not greater than the limits for CE102 as defined in MIL-STD-461E, except that above 150 kilohertz (kHz) the limits are allowed to be 20 (dB) below the prescribed values.				
192	“	“	Similarly, radiated emission over the frequency range of 30 kHz to 400 megahertz (MHz), at a distance of 20 feet (6.1 meters) shall be no greater than the limit for RE102 of MIL-STD-461E.	<u>I</u>		<u>4.5.12</u>	
193	3.12	Electrical components	Electrical components must meet the requirement specified herein unless otherwise noted.				
194	3.12.6	Electrical connectors	Electrical connectors shall be in accordance with FAA-G-2100G section 3.3.1.3.3.	<u>I</u>	<u>I</u>		
195	3.12.7	Printed wiring boards	Printed wiring boards, assemblies and components mounting shall conform to FAA-G-2100G, paragraphs 3.2.2.1 and 3.2.2.2, with the exception of paper base copper-clad laminates which are prohibited.	<u>I</u>			
196	“	“	Conformal coating is required and shall be in accordance with FAA-G-2100G paragraph 3.3.1.3.7b.	<u>I</u>	<u>I</u>		
197	3.12.8	Component ratings	When component ratings are not specified, they shall be selected to ensure that the components are not operated in excess of 80 percent of their normally derated maximum values for the temperatures encountered under the specified equipment environmental conditions.	<u>A</u>	<u>I</u>		
198	“	“	Derating of electronic components shall be in accordance with MIL-HDBK--454, Requirement 18.	<u>I</u>	<u>I</u>		
199	3.13	Materials and parts	Materials and parts shall be as specified herein	<u>I</u>	<u>I</u>		
200	“	“	. Materials and parts not specifically designated by standard, or specification shall meet the requirements of FAA-G-2100G.	<u>I</u>	<u>I</u>		
201	“	“	All materials and parts shall be suitable of operation under the environmental conditions specified in 3.9.	<u>A</u>			
202	3.13.1	Metals	Metals shall be either inherently corrosion resistant or suitably protected to resist corrosion or oxidation.	<u>I</u>	<u>I</u>		
203	“	“	The use of dissimilar metals shall be in accordance with MIL-STD-889. Parts may be suitably coated to prevent corrosion or seizing of parts that require removal for servicing.	<u>I</u>	<u>I</u>		
204	3.13.2	Aluminum	Aluminum shall be in accordance with American Society for Testing and Materials (ASTM) B241, B221and B211.	<u>I</u>	<u>I</u>		
205	“	“	Aluminum alloy plate and sheet, aluminum alloy die castings, and aluminum alloy sand castings shall be in accordance with ASTM B 209, B26, B108, B85.	<u>I</u>	<u>I</u>		
206	“	“	Aluminum alloy castings, if used, shall be impregnated in accordance with MIL-STD-276.	<u>I</u>	<u>I</u>		

207	3.13.3	Optical covers	Light transmitting covers shall conform to the requirements of MIL-C-7989B section 3.5.2	I	I		
208	3.13.4	Gaskets	Gaskets used at separable joints for cushioning and sealing purposes shall be made of neoprene and shall be suitable for use at ambient temperatures of -55°C(-67°F) to + 65°C (+149°F)	I	I		
209	3.13.5	Nameplates	Nameplates conforming to FAA-E-2100G paragraph 3.3.3.1 shall be installed at convenient locations on the LHA, the carrying and storage case, and the power and the control assembly.	I	I		
210	“	“	Each nameplate shall be attached to each assembly with four aluminum rivets or drive screws.	I	I		
211	3.13.5.1	Instruction plate	The 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.	I	I		
212	“	“	The instruction plate shall be made of aluminum.	I	I		
213	3.14	Brazing	Brazing shall be in accordance with MIL-HDBK-454, Requirement 59, except that electrical connections shall not be brazed.	I	I		
214	3.15	Soldering	Soldering shall be in accordance with MIL-HDBK-454, Requirement 5.	I	I		
215	3.17.1	Assembly	Assembly of all units shall be in a permanent manner with the components accessible for servicing, replacement, or repairs.	D	I		
216	“	“	Bolts used in assembling units shall be equipped with captive nuts;	I	I		
217	“	“	bolts shall be of sufficient length so that at least three full threads will show over the nut after tightening.	I	I		
218	“	“	Lock washers of the internal tooth type shall be used on all bolts where good electrical continuity is required for grounding.	I	I		
219	“	“	The chassis shall not be used as a current-carrying part of the electrical circuitry.	I	I		
220	3.17.2	Wiring	Connecting wires shall be copper and shall have the proper insulation rating and be of adequate AWG size for the application, as specified in National Electric Code Article 310	I	I		
221	“	“	Unless otherwise specified, the wires and wiring shall conform to the National Electrical Code for panel-board wiring.	I	I		
222	“	“	Wire bends with short radii shall be taken to avoid nicking or cutting the conductors.	I	I		
223	3.17.3	Marking	All equipment components shall be clearly identified by nameplates or bold permanent type stencils.	I	I		
224	“	“	Identification markings shall agree with	I	I		

			designations on the wiring diagram and parts list.				
225	“	“	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.	<u>I</u>	<u>I</u>		
226	“	“	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.	<u>I</u>	<u>I</u>		
227	“	“	The terminating points for all wires and cables at terminal blocks, as well as the terminal blocks, shall be clearly identified.	<u>I</u>	<u>I</u>		
228	“	“	The identification shall correspond to the circuit and terminal designations as shown on the interconnection wiring diagram and on applicable diagrams contained in the instruction book	<u>I</u>	<u>I</u>		
229	3.18	Workmanship	Workmanship shall be in accordance with MIL-HDBK-454, Requirement 9.	<u>I</u>	<u>I</u>		
230	3.19	Monitored points and controls	Test points shall be provided on all signals that are required to be monitored during checkouts, alignment, and calibration, or during preventive maintenance procedures.	<u>D</u>	<u>I</u>		
231	“	“	Test points shall not be located in compartments with voltage points of 500 volts or more, and all test points shall be located so as to preclude accidental shock to personnel engaged in normal operating or maintenance activities.	<u>I</u>	<u>I</u>		
232	“	“	The removal of components, modules, or circuit cards shall not be required to gain access to test points or adjustments.	<u>I</u>	<u>I</u>		
233	“	“	Test point controls and indicators mounted on printed wiring boards shall be accessible from the front of the circuit cage assembly without the use of extender boards.	<u>D</u>	<u>I</u>		
234	3.20.1	Maintainability design criteria					
235	“	“	Mean time to repair (MTTR) - the PAPI system shall have a MTTR of not more than 30 minutes and 99% of all repair times shall be less than two (2) hours The contractor will demonstrate conformance of this requirement by performing maintainability analysis by using MIL-HDBK-472 as guidance.	<u>A</u>	<u>I</u>		
236	“	“	Mean periodic maintenance time (MPMT)- The PAPI system MPMT shall be not greater than 2 hours per 3 months, including routine inspection.	<u>A</u>	<u>I</u>		
237	3.21.1	System reliability parameters					
238	“	“	Mean time between failures (MTBF) of the system, except for the lamps, shall be not less than 2,500 hours.	<u>A</u>	<u>I</u>		
239	“	“	The contractor shall demonstrate conformance	<u>A</u>	<u>I</u>		

			with the above requirements by performing a reliability analysis using data and techniques in accordance with MIL-HDBK-217 and MIL-HDBK-781.				
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APPENDIX B NAS-SS-1000 Requirements Trace

NAS-SS-1000 Paragraph	REQUIREMENT	FAA-E-2756 Paragraph	Comments
3.2.1.4.9	Precision approach path indicator (PAPI). The PAPI will provide visual descent guidance for a non-precision approach to a runway. The requirements for the PAPI shall be stated in the following subparagraphs:	3.1	
3.2.1.4.9.1	<u>Functional characteristics.</u> The PAPI shall provide the following functions:	N/A	
3.2.1.4.9.1.1	<u>Service.</u> The PAPI shall provide visual descent guidance that assures safe obstruction clearance to the pilot along a fixed single glide path to the touchdown point on a non-precision approach runway.	3.1	
3.2.1.4.9.1.2	<u>Operational control.</u> The PAPI shall respond to operational control (on/off) from the ATCT.	3.5.2	
3.2.1.4.9.1.3	<u>Radio control.</u> The PAPI shall respond to air-to-ground VHF/UHF radio control (on) at unmanned airports.		Requirement is in Radio Remote Control System (RRCS)
3.2.1.4.9.1.4	<u>Automatic operation.</u> The PAPI shall be capable of adjusting its intensity automatically in response to ambient lighting conditions.	3.5.2 & 3.5.3.1.4	
3.2.1.4.9.1.5	<u>Automatic shutdown.</u> The PAPI shall automatically turn off after a specified period following activation by a VHF/UHF aircraft transmitter.		Requirement is in Radio Remote Control System (RRCS)
3.2.1.4.9.1.6	<u>Maintenance monitoring.</u> The PAPI shall implement the maintenance monitoring functional characteristics as specified in 3.2.1.1.1.1 of Volume V of the NAS-SS-1000.		RMS requirements have been waived per AAF-1 memorandum dated February 3, 2003

3.2.1.4.9.1.7	<u>Maintenance and status data.</u> The PAPI link control unit (when installed) shall collect and transmit maintenance and status data from the PAPI.		RMS requirements have been waived per AAF-1 memorandum dated February 3, 2003
3.2.1.4.9.2	<u>Performance characteristics.</u> The PAPI shall meet the following performance characteristics:	N/A	
3.2.1.4.9.2.1	<u>Duration.</u> The PAPI shall remain activated for 15 minutes after responding to radio control from an aircraft.		Requirement is in A/G Receiver
3.2.1.4.9.2.2	<u>Intensity.</u> The PAPI shall have 2 brightness steps with relative intensities of 100 percent (day time use) and 8.5 percent (nighttime use).	3.5.2 & 3.5.3.1.4	
3.2.1.4.9.2.3	<u>Effective range.</u> The PAPI shall have an effective visual range during clear weather of at least 3 miles during the day and 20 miles at night.		
3.2.1.4.9.2.4	<u>Glide path angle.</u> The PAPI shall be adjustable to provide visual glide path guidance between glide path angles of 1.5 to 6.0 degrees.	3.3.9	
3.2.1.4.9.2.5	<u>Lateral coverage.</u> The PAPI shall provide usable visual approach guidance out to at least ± 10 degrees either side of the extended runway centerline.	Figure 5	
3.2.1.4.9.2.6	<u>Automatic intensity selection.</u> When in automatic mode, the PAPI shall operate at: High intensity when the illumination on a vertical surface facing north exceed 58 ± 2 foot candles; Low intensity when the illumination drops to 35 ± 2 foot candles.	3.5.2 & 3.5.3.1.4	
3.2.1.4.9.2.7	<u>Link control unit.</u> The PAPI link control unit (when installed) shall provide: Subsystem status and performance data collection;		RMS requirements have been waived per AAF-1 memorandum dated February 3, 2003

	<p>Message and control transfers: local and remote;</p> <p>An input/output port for a portable maintenance data terminal.</p>		
3.2.1.4.9.2.8	<p><u>Maintenance monitoring performance characteristics.</u> The PAPI shall meet the maintenance monitoring performance characteristics as specified in 3.2.1.1.1.2 of Volume V of the NAS-SS-1000.</p>		<p>RMS requirements have been waived per AAF-1 memorandum dated February 3, 2003</p>
3.2.1.4.9.3	<p><u>Functional/physical interfaces.</u> The PAPI shall interface functionally and physically as shown in Figure 3.2.1.4.9.3-1. The PAPI functional interfaces are defined in Table 3.2.1.4.9.3-1.</p>		<p>The signals defined in table 3.2.1.4.9.3-1 are RMS signals and RMS requirements were waived per AAF-1 memorandum dated February 3, 2003</p>