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## **DEPARTMENT OF TRANSPORTATION**

### **FEDERAL AVIATION ADMINISTRATION**

#### **PERFORMANCE SPECIFICATION**

#### **RUNWAY END IDENTIFIER LIGHTS (REIL)**

Navigation Services  
Lighting Systems Office

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## 1. SCOPE

1.1 Scope. This specification covers the requirements of the Federal Aviation Administration (FAA) for a Runway End Identifier Lights (REIL) system consisting of two flashing lamp assemblies and associated equipment at the approach end of runways.

## 2. APPLICABLE DOCUMENTS

2.1 FAA documents. The FAA specifications, standards, and drawings of the issues specified in the invitation-for-bids or request-for-proposals form a part of this specification.

### 2.1.1 FAA specifications.

FAA-E-1100	Photometric Test Procedures for Flashing Lamps
FAA-G-2100	Electronic Equipment, General Requirements
FAA-D-2494	Technical Instruction Book Manuscripts: Electronic Equipment, Requirements for: Preparation of Manuscripts
FAA-C-1217	Electrical Work, Interior
FAA-E-2723	Remote Radio Control System
FAA-E-2663	MALSR Remote Control Interface Unit
AC 150/5340-27A	Air-to-Ground Radio Control of Airport Lighting Systems
AC 150/5345-47	Isolation Transformers for Airport Lighting Systems

### 2.1.2 FAA standards.

FAA-STD-019	Lightning and Surge Protection, Grounding, Bonding and Shielding Requirements for Facilities and Electronic Equipment
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### 2.1.3 FAA drawings.

C-6046	Frangible Coupling, Type 1 and 1A, Details
C-21216	Standard Nameplate

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 requests-for-proposals form a part of this specification.

### 2.2.1 Military specifications.

MIL-A-8625	Anodic Coatings for Aluminum and Aluminum Alloys
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MIL-C-7989	Cover, Light Transmitting, for Aeronautical Lights, General Specification for
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### 2.2.2 Military standards.

MIL-STD-276	Impregnation of Porous, Nonferrous Metal Castings
MIL-STD-461	Electromagnetic Emission and Susceptibility, Requirements for the Control of Electromagnetic Interface
MIL-STD-810	Environmental Test Methods
MIL-STD-889	Dissimilar Metals
MIL-STD-961	Department of Defense Standard Practice for Defense Specifications
MIL-HDBK-217	Reliability Prediction of Electronic Equipment
MIL-HDBK-454	General Guidelines for Electronic Equipment
MIL-HDBK-470	Designing and Developing Maintainable Products and Systems
MIL-HDBK-781	Reliability Test Methods, Plans, and Environments for Engineering, Development, Qualification and Production, Handbook for

### 2.3 Federal standard.

FED-STD-595	Color (requirement for individual color chips)
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2.4 Other publications. The following publications, covering the issues in effect on the date of the invitation-for-bids or request-for-proposals, form a part of this specification.

#### 2.4.1 National Electrical Manufacturers Association (NEMA).

NEMA 250	Enclosures for Electrical Equipment (1,000 Volts Maximum)
NEMA 4X	Watertight and Dusttight Indoors and Outdoors (Enclosure)

#### 2.4.2 American National Standards Institute (ANSI).

ANSI/IPC-CC-830	Electrical Insulating Compound for Printed Wiring Assemblies, Qualification and Performance of
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2.4.3 Association for Iron and Steel Technology (AIST).

ISS 224	Steel Product Manual: Stainless Steels
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2.4.4 National Fire Protection Association Publications.

NFPA No. 70	National Electrical Code (NEC)
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2.4.5 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, Wire, Profiles, and Tubes
B241	Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube
B633	Electrodeposited Coatings of Zinc on Iron and Steel, Standard Specification for

2.4.6 Institute for Printed Circuits (IPC).

IPC-CC-830	Electrical Insulating Compound for Printed Wiring Assemblies, Qualification and Performance of
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2.4.7 Society of Automotive Engineers (SAE).

SAE-AS25050	Colors, Aeronautical Lights and Lighting Equipment, General Requirements For
SAE-AMSQQP416	Plating, Cadmium (Electrodeposited)

2.4.8 Underwriters Laboratories (UL) Inc.

UL 1059	Terminal Blocks
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(Copies of this specification and other applicable FAA documents may be obtained from the Contracting Officer in the office issuing the invitation-for-bids or requests-for-proposals. The requests should fully identify material desired, i.e., standard, drawing, specification, and amendment numbers and dates. Requests should cite the invitation-for-bids, requests-for-offer, or contract involved or other use to be made of the requested material.)

(Copies of Military documents may be obtained online at <http://www.dsp.dla.mil>.)

(Information on obtaining copies of Federal specifications and standards may be obtained from General Services Administration, Federal Supply Service, FSS Product Acquisition Center, Supply Standards Division (FLAS), Washington, DC 20406. Documents can also be obtained online at <http://www.dsp.dla.mil>.)

(Information on obtaining NEMA publications may be provided by the National Electrical Manufacturers Association, 1300 North 17<sup>th</sup> Street, Suite 1847, Rosslyn, VA 22209. Documents can also be obtained online at <http://www.nema.org>.)

(Information on obtaining ANSI and IPC standards may be provided by the American National Standards Institute, 25 West 43<sup>rd</sup> Street, 4<sup>th</sup> Floor, New York, NY 10036. Documents can also be obtained online at <http://www.ansi.org>.)

(Copies of National Fire Protection Association (NFPA) documents can be obtained from NFPA, 1 Batterymarch Park, Quincy, MA 02169-7471. Documents can also be obtained online at <http://www.nfpa.org>.)

(Copies of AIST standards may be obtained from the Association for Iron and Steel Technology, 186 Thorn Hill Rd, Warrendale, PA 15086-7528, (724) 776-6040. Documents can also be obtained online at <http://www.aist.org>.)

(American Society for Testing and Materials (ASTM) standards can be obtained from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959. Documents can also be obtained online at <http://www.astm.org>.)

(Society of Automotive Engineers (SAE) standards can be obtained from SAE World Headquarters, 400 Commonwealth Drive, Warrendale, PA 15096-0001. Documents can also be obtained online at <http://www.sae.org>.)

(Underwriters Laboratories Inc. (UL) standards can be obtained from Underwriters Laboratories, Inc., 333 Pfingsten Road, Northbrook, IL 60062-2096. Documents can also be obtained online at <http://www.ul.com>.)

### 3. REQUIREMENTS

3.1 Equipment comprising a REIL system. This specification describes the following elements of a REIL system:

- a. Control cabinet including lightning arrestors (3.4.1)
- b. Two each identifier assemblies (3.4.2)
- c. Aiming device (3.4.3)
- d. Site spare parts (3.13)
- e. Instruction books (6.3).

3.2 Other equipment. Equipment that is required for the complete REIL system but is not described within this specification includes frangible couplings (FAA drawing C-6046); 2-inch electrical metallic tubing (emt) conduit (FAA-C-1217); 6.6/6.6 ampere (A) or 20/6.6 A isolation transformers (AC 150/5345-47) of appropriate power rating for the intended application, and junction box.

3.3 General functional requirements for the REIL system. The runway end identifier flashing light units (hereafter referred to as identifier units) will be used to indicate the approach end of a runway (figure 1). One identifier unit (see 6.4.3)

shall be located on each side of the approach end of the runway and both units shall flash simultaneously twice a second. The runway end identifier system shall be controlled (on-off) by either: (a) sensing the current in an existing runway edge lighting circuit, (b) activating a switch in the control cabinet, or by (c) remote control. An isolation transformer shall be used to isolate the control circuit of the identifier units from the high voltage circuit of the runway edge lights. The identifier unit shall have the capability of being operated at three different intensities. Intensity setting of the identifier units shall be accomplished by switching capacitors in the identifier assembly or by other electrical methods. The control cabinet shall provide the capability to manually (a) energize/de-energize the identifier units, and (b) permit automatic, manual, and remote control operation of the identifier units respectively. Power for operation of the identifier units shall be derived from a 120/240  $\pm$ 10 percent volt (V) alternating current (ac), single phase 3-wire plus ground, 60 hertz (Hz) constant potential source. The REIL shall have an effective visual range during clear weather of at least 3 miles during the day and 20 miles at night.

3.4 REIL system operating requirements. In the automatic mode, the identifier units will operate in conjunction with an existing runway edge lighting circuit that is a series circuit, powered by a constant current regulator. This series circuit may be either a high intensity runway light (HIRL) circuit having five different current steps, or a medium intensity runway light (MIRL) circuit having three different current steps (see Table I). Operation of the identifier units in the auto mode shall be accomplished automatically by sensing the current in the runway edge lighting circuit. When the runway edge lights are on, the REIL will be on. The system may also be operated manually or remotely. The REIL system block diagram is shown in figure 2.

3.4.1 Control cabinet. The control cabinet shall be an outdoor, NEMA Type 4X enclosure of sufficient size to accommodate all of the necessary components and wiring. The control cabinet must meet the NEMA 250 requirement. The cabinet shall be provided with adequate internal clearance to facilitate installation and maintenance of components. The cabinet housing shall be constructed to meet the requirement of 3.5.8 and shall not distort or bend under normal methods of shipping, handling, installation, and maintenance. The cabinet housing shall be constructed of stainless steel, aluminum, or of a nonferrous material which is comparable in service life to a stainless steel or aluminum housing over the full range of environmental and operating parameters defined in 3.5. Aluminum, if used, shall be anodized in accordance with MIL-A-8625F. The cabinet housing shall have a hinged door with provisions for padlocking (Best brand padlock, series 11B, with a 2-inch shackle). Means shall be provided to secure the door firmly in the closed position maintaining the requirements of 3.5. A doorstop shall be provided to hold the door open at least 120°. A panel shall be installed in the rear of the cabinet upon which all components are to be installed; this panel shall not be constructed of wood. Mounting bolts shall not protrude through the cabinet. The cabinet shall be provided with the capability to mount the cabinet in the vertical position. A properly marked ground lug shall be provided in the cabinet for a No.4 ground wire. Space shall be reserved for field installation of conduits for all external cable connections. As an option, the control cabinet's equipment may be housed inside one of the identifier assembly enclosures.

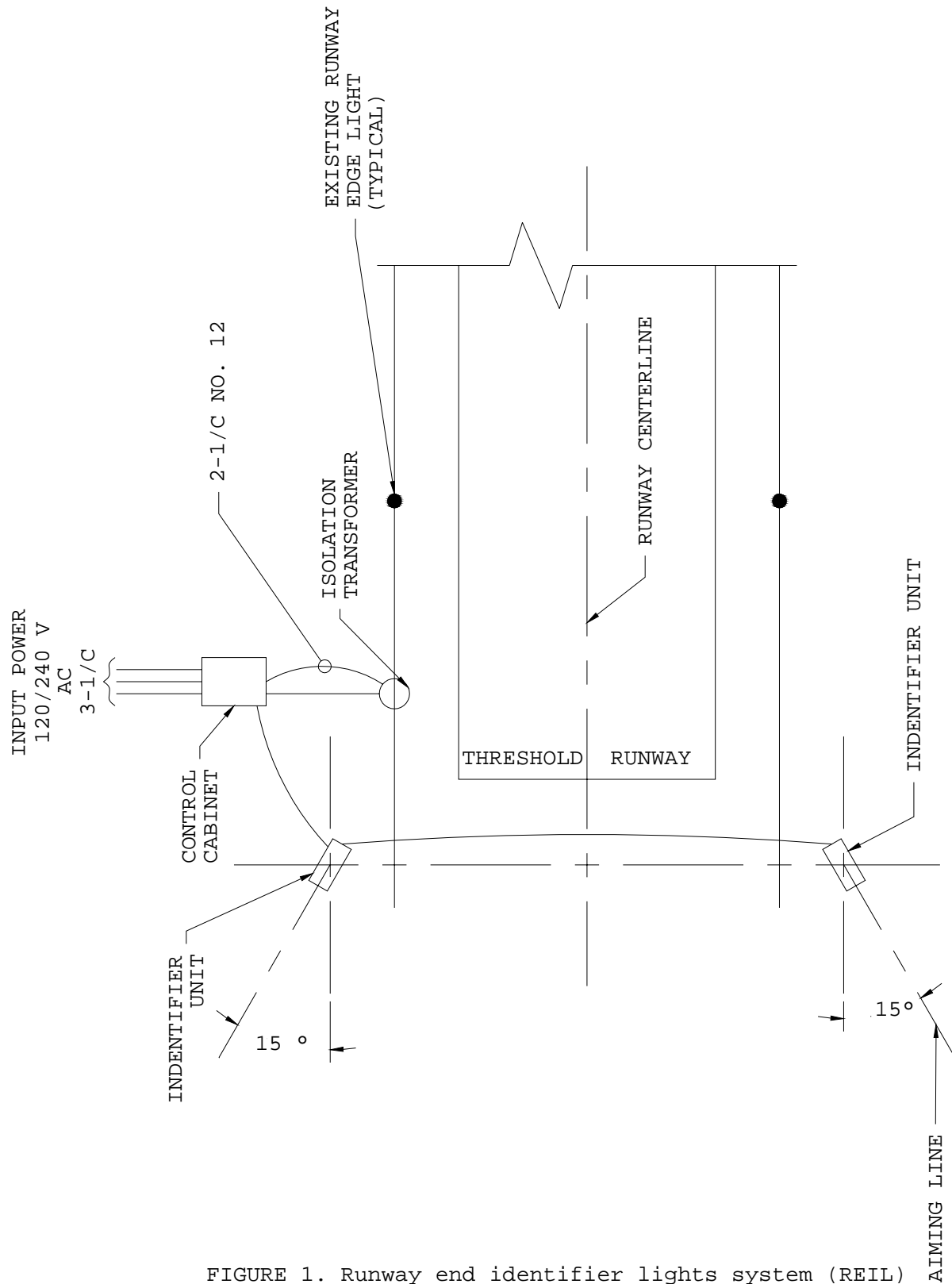


FIGURE 1. Runway end identifier lights system (REIL)

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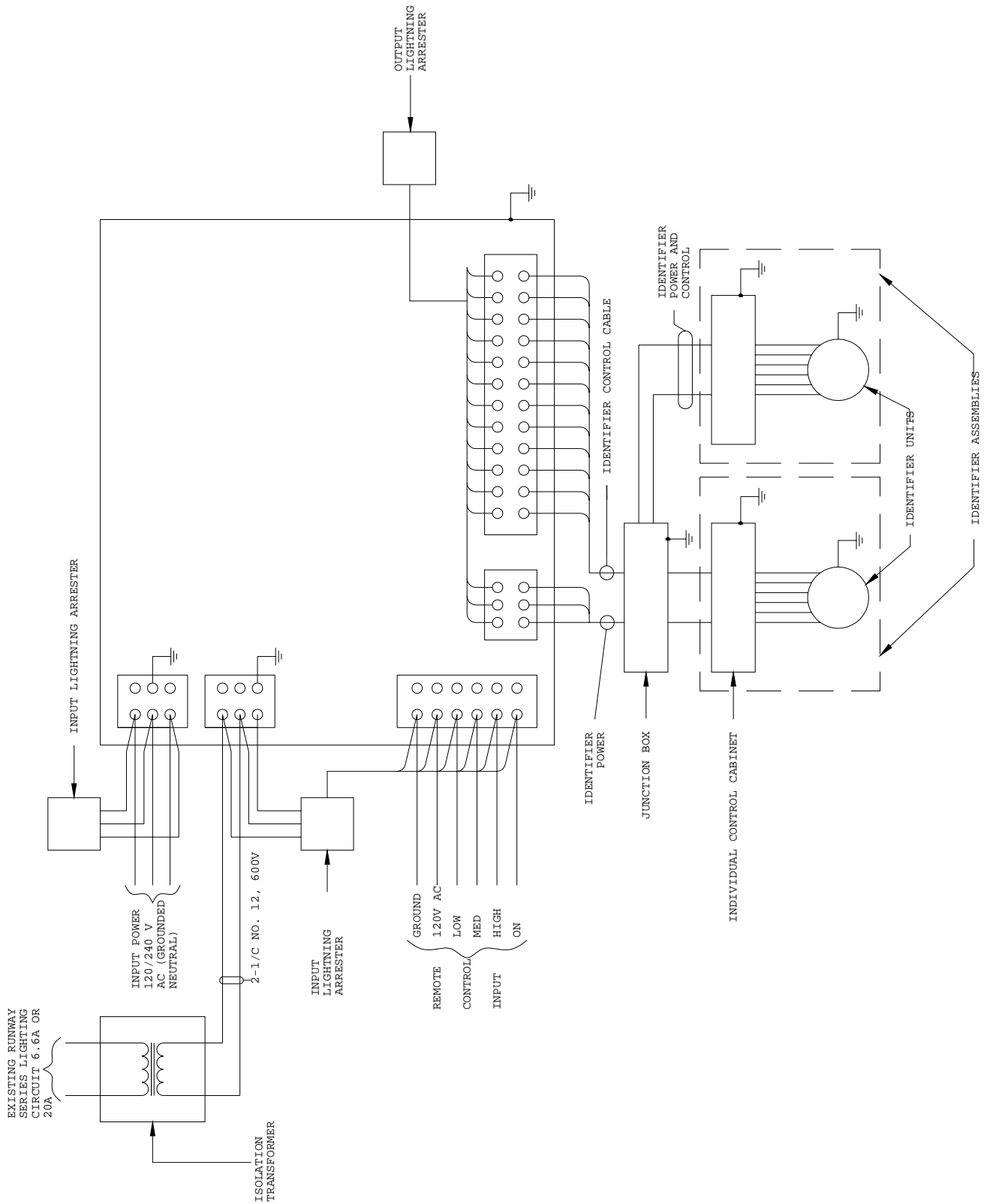


FIGURE 2. REIL system block diagram

3.4.1.1 Power and control circuitry. The control cabinet shall have the capability to detect misfires of identifier units accumulated over a 100-trigger sample interval. The number of misfires within the interval shall be compared to a threshold value set by a manual device inside the cabinet. When the preset threshold value is exceeded, the identifier unit shall be considered failed, and its corresponding failure (see 6.4.1) signal shall be routed to a visual indicator inside the control cabinet. The manual device shall allow the threshold value to be varied, in integer numbers, from 1 to 7. Once the threshold has been exceeded, the failure detection circuit shall not be reset until either the reset pushbutton or the on/off selector switch (3.4.1.4) is actuated. No additional wiring to the identifier units shall be required for this failure detection function. Identifier unit failure indicators shall be an integral part of the failure detection circuitry. The control cabinet shall provide NFPA 70 NEC/FAA-STD-019d compliant power and control signals to each identifier assembly via the junction box (if used).

3.4.1.2 Intensity step changing. All identifier units shall be designed for three intensity levels (high, medium, and low). Intensity step changing of the identifier units will be controlled from the control cabinet (see 3.4.1.5). In order to effectively switch flash capacitors, the control cabinet may automatically interrupt power to the identifier assembly for a period not to exceed 2 seconds during intensity step changing. The design of the control cabinet intensity step changing circuitry shall exclude the use of mechanical-type relays.

3.4.1.3 Current sensing switch. A current sensing switch shall be provided in the control cabinet to automatically control the on-off and intensity step change operations of the identifier units when the control switch (3.4.1.4) is in the AUTO mode. This shall be accomplished by sensing the current in a runway edge lighting circuit. The input to the current sensor will be obtained from the secondary of either a 6.6/6.6 ampere or 20/6.6 ampere, 5 kilovolt (kV) isolation transformer (in accordance with AC 150/5345-47E). The primary of the isolation transformer will be connected to the runway edge lighting circuit. The current sensor switch shall operate properly when located between 100 to 1,500 feet (30.5 to 457 meters) from the isolation transformer, and when the transformer and the current sensor switch are interconnected by a 2-conductor No. 12 cable. (The isolation transformer and cable are not furnished under this specification, but one or more of the transformers will be required for factory tests.) The current sensor shall sense the current from the isolation transformer. This current will vary, depending upon the number of burned out lamps in the runway edge lighting circuit. The design of the current sensor shall provide protection of solid-state components against lightning, current surges, and voltage surges of 1,500 volts peak-to-peak, 60 Hz, as may be encountered in a series lighting circuit. The current sensing switch shall contain an adjustable time delay of 0 to 4 seconds. This time delay will permit uninterrupted operation of the identifier units when they are used with runway lighting circuits in which the current is interrupted during intensity step changes.

3.4.1.3.1 Operation of current sensing switch. The switch shall operate over a range of 0.5 to 7.0 amperes root-mean-square (rms) with an input voltage to the control cabinet of 120/240 V ac  $\pm 10$  percent. The identifier units shall be shut off when the current in the runway edge lighting circuit drops below 0.5 amperes rms for more than 4 seconds.

3.4.1.4 Control switches. Two switches or other manual devices equal to, or better, that can be utilized for the following functions, shall be installed in the control cabinet to permit on/off, automatic, local, and remote control operation of the

identifier units. The first, labeled IDENTIFIERS, shall be capable of turning the identifier units on/off, as indicated below:

<u>Switch Position</u>	<u>Function</u>
ON	Identifier units are energized
Identifiers	
OFF	Identifier units are de-energized.

The second shall be labeled with five-positions providing for step control of the system, beginning with the REMOTE function, as indicated below:

<u>Switch Position</u>	<u>Function</u>
REMOTE	Identifier units remotely controlled
AUTO	Identifier units operate automatically in conjunction with runway lighting circuit
LOW	Identifier units operate on low intensity
MEDIUM	Identifier units operate on medium intensity
HIGH	Identifier units operate on high intensity.

If switches are used, play and backlash shall be held to a minimum, commensurate with intended operational functions, and shall not cause poor contact or inaccurate settings. Each functional position shall be identified by a mechanical stop, as well as by a position. Table I shows the intensity levels on the identifier units as a function of the loop current in the runway lighting circuit, when the selector switch is in the AUTO position.

TABLE I. Runway lighting circuit loop currents and identifier intensity levels

<b>Runway Lighting Circuits</b>	<b>Loop Current (Amperes)</b>	<b>Identifier Intensity Levels</b>
MIRL	6.6 ±3% 5.5 ±3% 4.8 ±3%	High Intensity Medium Intensity Low Intensity
HIRL (6.6 ampere Circuit)	6.6 ±3% 5.2 ±3% 4.1 ±3% 3.4 ±3% 2.8 ±3%	High Intensity High Intensity Medium Intensity Low Intensity Low Intensity
HIRL (20 ampere Circuit)	20.0 ±3% 15.8 ±3% 12.8 ±3% 10.3 ±3% 8.5 ±3%	High Intensity High Intensity Medium Intensity Low Intensity Low Intensity

3.4.1.5 Remote control circuitry. External remote control input signals to the control cabinet shall be in accordance with FAA-E-2723, Remote Radio Control

System, FAA-E-2663, MALSR Remote Control Interface Unit, and AC 150/5340-27A, Air-to-Ground Radio Control of Airport Lighting Systems. A terminal block meeting the requirements of 3.4.1.12 shall be provided in the control cabinet for remote control input. The terminal block shall have two spare terminals, in addition to the six terminals designated below:

1. Neutral
2. 120 V ac
3. Low intensity
4. Medium intensity
5. High intensity
6. Identifiers on/off.

The neutral terminal (a) shall be connected to the neutral bus. The (b) terminal shall be connected by a separately fused (10 ampere fuse) line to a 120 V ac source within the control cabinet. The (c) terminal is energized (120 V ac) by external control when either the low, medium, or high intensity step is selected. When terminal (c) alone is energized by external control, the identifier units shall turn on to the low intensity step. Terminal (d) is energized (120 V ac) by external control when either the medium or high intensity step is selected. When terminal (d) and terminal (c) are energized, the identifier units shall turn on to the medium intensity step. Terminal (e) is energized (120 V ac) by external control when the high intensity step is selected. When terminal (e), terminal (c), and terminal (d) are energized, the identifier units shall turn on to the high intensity step. Terminal (f) is energized (120 V ac) by external control to turn the identifier units on. When terminal (f) is energized, the identifier units shall turn on to the intensity step determined by inputs to terminals (c), (d), and (e). De-energizing of terminals (c), (d), and (e) shall turn off the identifier units. The system, when energized from the off position, shall come on at low intensity and then switch to a higher intensity if a higher intensity is selected. All intensity changes shall be completed within 1.5 seconds of initiating the intensity change. The power output to the identifier units may be interrupted up to a maximum of 1.5 seconds, if required, during intensity step change operations. Circuitry shall prevent intensity step changing during the discharge of an identifier assembly capacitor.

3.4.1.6 Entrance switch. A two-pole, 30 A, 240 V ac, heavy duty, dead-front safety switch box equipped with a 30 A, two-pole, thermal-magnetic circuit breaker shall be provided as the primary disconnecting device in the 120/240 V ac input service. The operating mechanism shall be quick-make and quick-break. The switch box shall be mounted in the control cabinet at a location that will provide easy and safe access to the operating handle.

3.4.1.7 Switching devices. Solid-state switching devices of adequate rating and suitable for the intended application shall be provided for on-off switching of power to the identifier units. The solid-state switching devices shall be controlled by a current sensor switch, or by an on/off control switch. Filtering for spike elimination is required to prevent interference with other equipment on the same power service.

3.4.1.8 Master timer. An electronic timer shall be installed in the control cabinet to provide simultaneous pulses to the identifier units. The timer shall provide

pulses not to exceed 120 V (ac/dc) to each identifier assembly twice a second (500 milliseconds  $\pm$  25 milliseconds). The pulse duration shall be 4 milliseconds ( $\pm$  2 milliseconds).

3.4.1.9 Elapsed time meter. The control cabinet shall have the capability to indicate the number of hours of operation for all intensities. The indicator shall reflect up to 99,999.9 hours and shall indicate total time in hours and tenths of hours.

3.4.1.10 Maintenance light and convenience outlet. A maintenance light shall be installed in the control cabinet to provide adequate illumination for nighttime maintenance operations. Means shall be provided to protect the light from accidental contact. The light shall have an on-off switch that is easily identifiable in the dark and shall be properly fused. Both the light and receptacle shall be usable even though the entrance switch is open. A 120 volt, single phase, 15 ampere, grounding type receptacle, with built-in ground fault interrupter fused at 15 amperes, shall be installed in the control cabinet for maintenance purposes.

3.4.1.11 Lightning arresters. Lightning arresters that meet the requirements of 3.6 shall be installed in the control cabinet to protect each input and output power terminal and each output control signal. The lightning arresters shall be wired to the terminal block specified in 3.4.1.12.

3.4.1.12 Terminal Blocks. All external connections shall terminate on terminal blocks of adequate size and voltage rating. The terminal blocks shall be the enclosed base type with pressure-plate type terminal connectors that satisfy UL 1059. All terminals shall be shielded to prevent accidental contact, and shall be marked as specified in FAA-G-2100G paragraphs 3.3.3.2a, 3.3.3.2b, and 3.3.3.2.1.2. The ends of all bare stranded wires terminated in a terminal block shall be tinned. Stranded and solid type wires shall not be terminated in the same terminal of a terminal block. In addition, wires of different gauges shall not be terminated in the same terminal of a terminal block.

3.4.2 Identifier assembly. An identifier assembly shall consist of an individual control cabinet and a flasher light unit (identifier unit). The functions of the individual control cabinet and the identifier unit may be combined into a single unit. As an option, the individual control cabinet's equipment may be housed inside the control cabinet's enclosure.

3.4.2.1 Individual control cabinet. The triggering circuit of each identifier unit shall be located in the individual control cabinet. The trigger circuit of each individual control cabinet shall be energized from the control cabinet and as determined by the master timer. A detection device that will monitor the operation of the identifier unit when a trigger pulse is received from the control cabinet shall be incorporated in the design of the individual control cabinet circuitry. The output signal of the detection device shall be routed to the control cabinet. The individual control cabinet shall operate satisfactorily when located up to 3,000 feet (914.4 meters) from the master controller. The design of the triggering circuits shall be such that failure of one unit will not affect operation of the remaining unit. The individual control cabinet's enclosure shall be an outdoor, liquid-tight, dust-tight, and non-ventilated enclosure made of stainless steel, aluminum, or of a nonferrous material which is comparable in service life to a stainless steel or aluminum housing over the full range of environmental and operating parameters defined in 3.5. When used, aluminum shall be anodized in accordance with MIL-A-8625F. The enclosure shall be constructed to meet the requirements of 3.5 and shall not distort or bend under normal methods of shipping, handling, and installation. The enclosure shall be of sufficient size to

accommodate all of the necessary components and wiring, and provide adequate clearances for field installation and maintenance. It shall have mounting means external to the enclosure cavity, and position for locking, and shall not have knockouts. Terminal blocks shall be located near the cable entrance to permit termination of all external power and control wires feeding into the enclosure. Internal or external mounting bolts shall not protrude through the enclosure. Door gaskets shall be continuous molded gaskets and shall be resistant to deterioration such as cracking, hardening, or softening under the environmental conditions specified herein.

3.4.2.2 Identifier unit. The identifier units shall flash simultaneously twice a second (500 milliseconds  $\pm$  25 milliseconds). The identifier unit housing shall be constructed of stainless steel or aluminum, or of a nonferrous material which is comparable in service life to a stainless steel or aluminum housing over the full range of environmental and operating parameters defined in this specification. The identifier unit shall permit continuous vertical adjustment of the light beam axis from horizontal to 25° above horizontal. The horizontal beam axis shall be perpendicular to the lamp cover glass or window. All components in the identifier unit shall be readily accessible for maintenance purposes. Cable fittings shall provide both a waterproof and a strain relieved connection to the housing. The fittings shall not cause a permanent set on the cable insulation. If an FAA approved PAR-56 lamp holder is used, the requirements of this paragraph will be considered met.

3.4.2.2.1 Flash tube. If used, flash tubes shall have a rated life of at least 1,000 hours when operated on the high intensity step. The effective intensity shall decrease not more than 30 percent during the minimum rated life, and flash skipping (misfiring) shall be less than 1 percent with no skips occurring consecutively. All flash tubes enclosed in a PAR-56 bulb will not require a window (3.4.2.2.2) or a reflector (3.4.2.2.3).

3.4.2.2.2 Window. The housing shall have a glass window installed to permit the maximum amount of light transmission from the optical system lamp reflector. The glass shall be aviation white in accordance with SAE-AS25050 (Asg) and shall be Class A in accordance with MIL-C-7989B. It shall be entirely free of bubbles, mold marks, or other imperfections which might impair light transmission. The gasket surface of all glass shall be either ground or molded to a sufficiently true surface to ensure a tight joint. The window shall be attached to the housing by watertight gaskets and mounted in such a manner that it can be easily replaced.

3.4.2.2.3 Reflector. A metal reflector with reflective surface shall be used to provide the light output and beam spread specified in 3.4.2.2.6.

3.4.2.2.4 Socket. The lamp socket, if used, shall be able to withstand the operating temperature of the flasher tube. Screw terminals shall be provided on the socket for required wire terminations.

3.4.2.2.5 Mounting attachments. Each identifier unit shall be assembled to a mounting base. The mounting base shall have an internal wireway for all the required wires to the lamp-holder. The holder/mounting base interface shall permit passage of all the wires required, regardless of the lamp-holder's vertical or horizontal adjustment angle. The mounting base shall permit rigid and easily adjustable mounting of the complete identifier unit by either capping the open top of a frangible coupling (FAA Drawing C-6046) or by capping the open top of a 2-inch (5.08 cm) electrical metallic tubing conduit. The identifier unit's overall height once installed shall be not greater than 34 inches (0.86 m) above grade.

3.4.2.2.6 Photometric requirements. The identifier units shall produce light intensities as shown in Table II. The effective intensity measurements shall be made over an elliptical pattern defined by the ellipse equation:

$$\frac{X^2}{a^2} + \frac{Y^2}{b^2} = 1$$

where  $X$  is the horizontal axis and  $Y$  is the vertical axis. The outer bounds of the beam (Figure 3) shall be not closer than  $\pm 15^\circ$  from the light unit centerline along the horizontal axis ( $a = 15^\circ$ ) and shall be not closer than  $\pm 5^\circ$  from the light unit centerline along the vertical axis ( $b = 5^\circ$ ). After 250 hours of continuously flashing twice per second, the lamp shall produce an effective intensity of no less than 70 percent of initial candlepower, and consecutive misses shall be no more than 1 percent. If flash tubes are used, the flash duration shall be not less than 250 microseconds or greater than 5,500 microseconds at 50 percent of the peak instantaneous candlepower. The optical system shall be designed to prevent misalignment during maintenance operations.

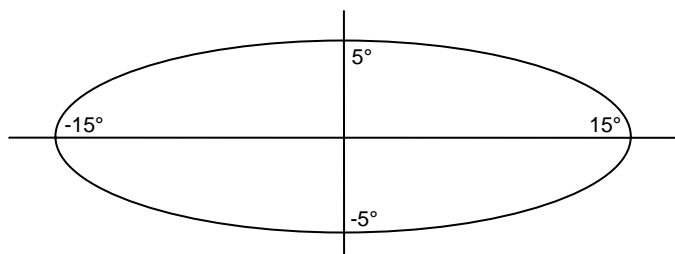


FIGURE 3. Identifier beam pattern

TABLE II. Light intensities

Intensity Setting	Maximum Allowable Effective Intensity (Candelas)	Minimum Effective Intensity (Candelas)
High	20,000	8,000
Medium	2,000	800
Low	450	150

3.4.2.3 Rating. Each identifier assembly shall consume no more than 500 volt-amperes at 240 volts, when measured with thermal meters giving a steady needle deflection or with a watt-hour meter. The surge current occurring at each flash shall be not greater than 9 amperes (rms) at 240 volts. The identifier assembly shall be capable of operating from 120/240 V ac source.

3.4.2.4 Relays. When used, the flash tube trigger relay shall be plug-in type to fit a standard octal socket and shall be enclosed in a dust cover.

3.4.2.5 Test points and controls. Test points shall be provided to monitor all signals used during checkout, alignment, calibration, or during preventive maintenance procedures. Test points shall not be located in compartments with exposed voltages 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 (see 6.4.2), 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.

3.4.3 Aiming device. The aiming device shall permit field aiming of the lamp axis perpendicular to the plane of the cover glass to any angle from 0° to +25° above the horizontal. The aiming device shall be capable of aiming an identifier unit mounted on a frangible coupling (FAA Drawing C-6046). The aiming angle shall be indicated on a scale calibrated in 1° intervals and shall be accurate within ±0.5° of the actual aiming angle with the device attached. The final aimed angle of the lamp with the device unattached shall be accurate within 1° of the actual angle.

3.5 Environmental conditions. The equipment shall be designed for continuous or intermittent operation outdoors under the following environmental conditions:

3.5.1 Temperature. In ambient temperature between -55° Centigrade (C) (-67° Fahrenheit (F)) and +70°C (+158°F).

3.5.2 Altitude. Sea level to 10,000 feet (3,048 meters) mean sea level (msl).

3.5.3 Humidity. Up to 100 percent relative humidity from sea level to 10,000 feet (3,048 meters) msl and +70°C ambient temperature.

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

3.5.5 Salt spray. Exposure to salt-laden atmosphere with relative humidity of up to 95 percent.

3.5.6 Rain. Exposure to wind-blown rain at a rate of 2 inches per hour.

3.5.7 Solar radiation (sunshine). Exposure of exposed surfaces (including light windows) to sudden application of cold water when the lights reach stable operating temperatures.

3.5.8 Vibration. The equipment shall be capable of withstanding vibrations in the frequency range of 10 to 2,000 hertz.

3.5.9 Temperature Shock. The system external surfaces (including projection lenses) shall withstand a sudden application of cold water at a temperature of 0° to +5° C when the lights reach stable operating temperatures at maximum intensity.

3.6 Transient suppression. The equipment shall be designed to withstand transient increases in the 120/240 V ac (rms) line voltage superimposed on the ac line voltage waveform and reaching a peak voltage of 500 V for as long as 50 milliseconds. In addition, the equipment shall use surge arrestors to withstand lightning line transients applied at the equipment input and output power terminals. The surge arrestors shall be certified to withstand the standards as specified in FAA-STD-019d, paragraphs 3.5, Conducted Power Line Surges, and FAA-G-2100G, paragraph 3.1.1.6(f), Circuit Overload Protection. The equipment shall restart automatically if an interruption or shutdown is experienced due to either type of transient. Equipment operational functions shall be unimpaired by the above transients when each type of transient is imposed a minimum of five times each to the input and output power terminals of the energized equipment. The return terminal of the lightning protector shall be connected to earth ground via a separate dedicated conductor no less than a No. 6 American Wire Gage (AWG). The

transient protection for signal lines shall be in accordance with FAA-STD-019d, paragraph 3.6, Conducted Signal, Data, and Control Line Transients.

3.7 Interference requirements. Conducted interference levels on the power leads, control leads, signal leads, and interconnecting cables between parts, shall be not greater than the limits for CE102, as defined in MIL-STD-461E (equipment class ID). Similarly, radiated narrowband and broadband interference levels shall be not greater than the limits for RE102 of MIL-STD-461E over the frequency range from 14 kilohertz (kHz) to 400 megahertz (MHz) at a distance of 20 feet (6.1 meters).

### 3.8 Reliability.

3.8.1 Reliability design criteria. The equipment shall meet the following reliability requirements:

<u>Equipment</u>	<u>Specified Mean Time Between Failures (MTBF)</u>
a. Control Cabinet	2,500 hours
b. Identifier Assembly	2,500 hours.

### 3.9 Maintainability.

3.9.1 Maintainability design criteria. The equipment shall meet the following maintainability requirements:

<u>Equipment</u>	<u>Mean Time to Repair (MTTR)</u>	<u>Maximum Repair Time</u>
a. Control Cabinet	0.5 hour	6 hours
b. Identifier Assembly	0.5 hour	4 hours.

3.9.2 General maintainability requirements. The additional requirements of paragraph 3.2.4, Maintainability, of FAA-G-2100G shall be met in its entirety.

### 3.10 Component requirements.

3.10.1 Interlock switches. Interlock switches shall be in accordance with FAA-G-2100G paragraph 3.3.5.1.6. Interlock switches shall be incorporated in the identifier unit, the individual control cabinet (if used), and the control cabinet. When the units are opened, the interlock switches shall:

- a. Disconnect all incoming power and control circuits, except the incoming power to the maintenance light and convenience outlet.
- b. If used, discharge all flash tube capacitors (individual control cabinet only) to a maximum value of 50 volts within 30 seconds. The requirement shall apply even if components that normally draw current from the high voltage circuits are removed.

In addition, if flash capacitors are used, the design shall provide for permanently connected bleeder resistors in the individual control cabinet to discharge the flash tube capacitors to a maximum value of 50 volts within 1 minute in event of

failure of the interlock switches. Means shall be provided to enable the interlock switches to be cheated when the units are opened.

3.11 Materials. Materials shall be as specified herein. Materials and parts shall be in accordance with paragraph 3.3.1 of FAA-G-2100G. All components and parts shall be suitable for operation under the environmental conditions specified in 3.5. The use of dissimilar metals in contact with one another shall be avoided wherever practicable. However, if their use cannot be avoided, they shall be used in accordance with MIL-STD-889B paragraph 5.1. All equipment components in the identifier unit, as defined herein, and furnished under this specification shall be interchangeable without alterations in circuitry for power or control. The components of the entire assembly shall be directly interchangeable with any other identifier furnished under this specification.

3.11.1 Printed wiring boards (pwb). All electronic components of the REIL system, except power devices, shall be mounted on printed wiring boards. Conformal coating of pwbs is required and shall conform to ANSI/IPC-CC-830.

3.11.2 Metals. Metals shall withstand the mechanical stress involved and shall be inherently corrosion resistant, or suitably protected after fabrication, to prevent corrosion or oxidation under the service conditions.

3.11.2.1 Stainless steel. Type 18-8 stainless steel shall be used for all bolts, nuts, and washers not subject to high stress requirements. At the option of the contractor, stainless steel may be used for any purpose for which another material is not definitely specified elsewhere herein or elsewhere in the contract specifications, provided that all stainless steels are of the following types:

Association for Iron and Steel Technology (AIST)  
Type Numbers

301	305	316L
302	308	317
302B	309	321
303	310	322
304	314	322A
304L	316	347

3.11.2.2 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 B209, B26, B108, and B85. Aluminum alloy castings, when used, shall be impregnated in accordance with MIL-STD-276A.

3.11.3 Protective coating. Protective coatings used for prevention of corrosion shall be as specified herein.

3.11.3.1 Anodizing. Aluminum parts on the exterior of the identifier unit that would be exposed to continuous moisture, salt-laden atmosphere, or mechanical damage, shall be Teflon penetrated, hard-coat anodized, and shall meet the requirements of MIL-A-8625F paragraph 1.2, Type I or Type II, Class 1 or Class 2, as applicable.

3.11.3.2 Plating. All steel parts used shall be zinc or cadmium-plated in accordance with ASTM B633 or SAE-AMSQQP416.

3.11.3.3 Painting. The individual components of the REIL system enumerated below shall be painted, at a minimum, as follows: All exposed surfaces of the identifier unit shall be protected by not less than a primer coat, a body coat, and a final coat of paint. The painted surfaces shall withstand the environmental conditions defined in 3.5 for the entire service life of the equipment without flaking, cracking, or allowing any corrosion of the underlying surface. Lead paint or paints containing isocyanates and hazardous substances shall not be used. Color shade shall be aviation gloss orange No. 12197, Federal Standard FED-STD-595. The final painted surface shall be free of blotches, scratches, and runs.

3.11.4 Gaskets. Gaskets used at separable joints for cushioning and sealing purpose shall be continuously molded neoprene and shall be capable of sustained operation at ambient temperatures of -55° C (-67° F) to +70° C (+158° F).

3.11.5 Adhesives. Adhesives, when used, shall be in accordance with MIL-HDBK-454A, guideline 23.

3.11.6 Electrical insulating materials. Insulators, insulation, and dielectric materials shall be in accordance with MIL-HDBK-454A, guideline 11.

3.12 Processes. Processes shall be in accordance with 3.3.1, Materials, Processes, and Parts, FAA-G-2100G.

3.12.1 Brazing. Brazing shall be in accordance with MIL-HDBK-454A, guideline 59, except that electrical connections shall not be brazed.

3.12.2 Cabling. Wiring shall be in accordance with the requirements of paragraph 3.3.1.3.10, Wiring, of FAA-G-2100G. The wiring sizing must be in accordance with National Fire Protection Association (NFPA) 70 National Electrical Code Article 310. All cables shall be marked in accordance with NFPA 70 NEC article 310-11.

3.12.3 Cable breakout wires. Each individual breakout wire lead that emerges from a cable shall be longer than necessary for its termination, with approximately 1 inch (25.4 mm) of slack wire neatly formed adjacent to its termination.

3.12.4 Soldering. Soldering shall be in accordance with MIL-HDBK-454A, guideline 5.

3.12.5 Lugs connected to screw terminals. When solder or solderless lugs are used to terminate wires, only one wire shall be connected to each lug. The lugs shall be clamped under screw terminals; not more than three lugs shall be clamped under one screw terminal. Individual wires shall be removable from the screw terminal by loosening or removing the screw.

3.12.6 Cable connector wiring. No more than one wire shall be attached to each contact or each cable connector, except that two wires may be attached to a crimp-type contact. The two wires connected together shall be not greater than the size of the connector pin.

3.12.7 Splices. Wires and cables shall not be spliced.

3.13 Site spare parts. One complete set of lowest replaceable units (LRU) shall be provided for the REIL control cabinet and the REIL identifier assembly. No spare extender boards shall be provided. Each spare pwb assembly shall have all components installed and tested as a complete assembly. All parts shall be packed separately from the control cabinet and identifier assemblies. The material used to wrap the site spares shall be static-free.

3.14 Parts rating. All parts shall be of adequate rating for the application and shall not be operated in excess of the parts manufacturer's recommended ratings during operation of the equipment throughout the specified environmental range. Components within the control cabinet shall be de-rated as required by the interior temperature rise above the maximum outside ambient temperature at 10,000 feet (3,048 meters) altitude.

3.15 Assembly and marking. All components shall be properly assembled and marked. Each electrical component or part thereof shall be identified by a reference designation marked adjacent to the physical location of the part in the equipment and readily visible to maintenance personnel. Such identification shall be identical to reference designations used in instruction books for equipment. Where possible, all wiring shall be laced into cables, neatly clamped, and properly marked in accordance with FAA-G-2100G, paragraph 3.3.1.3.10.2. Marking shall be in accordance with paragraph 3.3.3.2, Marking, of FAA-G-2100G as applicable.

3.16 Nameplate. Each cabinet and housing shall be furnished with a standard nameplate, in accordance with FAA Drawing C-21216, fastened to its outside surface with Type 430 or 18-8 stainless steel rivets or by removable 4-40 pan-head screws in accordance with paragraph 3.3.3.1, Nameplates, of FAA-G-2100G.

3.17 Workmanship. Workmanship shall be in accordance with MIL-HDBK-454A, guideline 9.

#### 4. VERIFICATION

4.1 VRTM. Appendix A contains the Verification of Requirements Traceability Matrix (VRTM) for the REIL. The VRTM cross-references the requirements in section 3 to section 4. Verification is accomplished by the following methods:

- a. Analysis. An element of verification that uses 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 that involves the actual operation of an item to provide evidence that the required functions were accomplished under specific scenarios. The items may be instrumented and performance monitored.
- c. Inspection. An element of verification that is generally nondestructive and typically includes the use of sight, hearing, smell, touch, and taste; simple physical manipulation; and mechanical and electrical gauging and measurement. The examination and testing of supplies and services to determine whether they conform to specified requirements.
- d. Test. An element of verification in which scientific principles and procedures are applied to determine the properties or functional capabilities of items.

4.2 Reliability analysis. Conformance to the requirements of 3.8.1 shall be accomplished by a reliability analysis using data and techniques in accordance with MIL-HDBK-217F and MIL-HDBK-781A. If the periodic maintenance replaces component(s) prior to their failure, this may be included in the analysis.

4.3 Test methods. Testing of the equipment shall be performed in two categories as described below.

4.3.1 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 requires the initial production of a group of identical units, e.g., two identifier units, then all members of the group will be referred to hereinafter as the production model. The production model shall be subjected to the tests specified in 4.4 as required by Table IV. At the conclusion of each test specified in 4.4.1 through 4.4.12, the production model of the REIL system shall undergo at least two cycles of the operational test 4.4.12. Failure of the equipment to meet the performance requirements specified herein shall be cause for rejection.

4.3.2 Production unit tests. Testing of the production unit shall start after acceptance of the production model. Tests on production units shall be as specified in 4.4 and as required by Table IV.

4.3.3 Type Tests. Tests shall be performed on regular production units in accordance with 4.2.2.2, Type Tests, FAA-G-2100G. The production unit under type test shall be subjected to the tests specified in 4.4 as required by Table IV. At the conclusion of each test specified in 4.4.1 through 4.4.12, the production model under type test shall undergo at least two cycles of the operational test 4.4.12.

#### 4.4 Tests.

4.4.1 Visual inspection. The equipment shall be visually inspected for workmanship, fabrication, finishing, painting, and adequacy of selected parts.

4.4.2 Humidity test. The humidity test shall be in accordance with Method 507.4, of MIL-STD-810F, a total of five complete cycles (240 hours) will be required and the maximum temperature shall be +60° C (+140° F).

4.4.3 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 +70° C (+158° F).

4.4.4 Temperature test. The high temperature test shall be in accordance with Procedure II, Method 501.4, of MIL-STD-810F, except the temperature shall be +70° C (+158° F). The low temperature test shall be in accordance with Procedure II, Method 502.4, of MIL-STD-810F, except the temperature shall be -55° C (-67° F), with the 2-hour operational test to start 2 hours after temperature stabilization. Procedure I shall be repeated three times.

4.4.5 Sand and dust test. The sand and dust test shall be in accordance with Procedures I and II, Method 510.4, of MIL-STD-810F; rotate the equipment 120° twice. Air velocities for blowing dust shall be 1.5 m/s (300 ft/min) to 8.9 m/s (1,750 ft/min). Air velocities for blowing sand shall be 18 m/s (3,450 ft/min) to 29 m/s (5,700 ft/min).

4.4.6 Salt Fog test. The salt fog test shall be in accordance with Procedure I, Method 509.4, of MIL-STD-810F, except that the relative humidity shall be up to 85 percent. The test shall be for not less than 168 hours. Salt buildup as a result of the test may be removed with tap water.

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

4.4.8 Solar radiation (sunshine) test. The solar radiation test shall be conducted in accordance with Procedure II, Method 505.4, of MIL-STD-810F. The equipment shall be operated for 1 hour during each cycle when the test item has reached its peak temperature.

4.4.9 Vibration test. The equipment shall be vibration tested to meet the requirements of 3.5.8.

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

- a. In a direction perpendicular to the test table (vertically).
- b. Horizontally, parallel to the light beam axis.
- c. Horizontally, at right angles to the light beam axis.

4.4.9.2 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 accelerations shown in Table III 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 III. 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 flash tubes, supports, etc.

TABLE III. Vibration test data

Maximum Acceleration in Gravities	Frequency Range, Hertz
2.0	10-70
3.0	70-200
3.0	200-500
3.0	500-2,000

4.4.10 Transient suppression test. The REIL system shall be connected as shown in figure 2, as applicable, and tested to verify compliance with the transient suppression requirements of 3.6.

4.4.11 Interference test. The equipment shall be connected as shown in figure 5, and tested to verify conformance with the interference requirements of 3.7. Measurement of the electromagnetic emissions shall be in accordance with test method CE03 of MIL-STD-461E. Measurement of the radiated emission shall be in accordance with test method RE02 of MIL-STD-461E.

4.4.12 Operational test. The control cabinet and identifier unit shall be connected as shown in figure 2, and operated for a period of 1 hour. The input to the REIL current sensor circuitry shall be derived from an isolation transformer (in accordance with AC 150/5345-47) and its primary current shall be varied from 0 to 7 amperes to check for proper operation of the sensor (see Table I). Operation of the identifier unit shall be attempted with the interlock switches in the open position to verify proper operation of the interlock switches. A test shall be made to check the intensity step function of the identifier unit. All operating requirements of the equipment shall be checked. Voltage and current shall be

recorded for the input power, input to the current sensor, and output of the control cabinet, for each intensity step.

4.4.12.1 The 150-hour test. The equipment shall be connected as shown in figure 2 and a 150-hour continuous operation test shall be performed on the production model. All intensities shall be checked using the remote control inputs to cycle the system as follows:

- a. Low intensity, 5 minutes,  $\pm 1$  minute
- b. Off, 2 seconds, maximum
- c. Medium intensity, 5 minutes,  $\pm 1$  minute
- d. Off, 2 seconds, maximum
- e. High intensity, 5 minutes  $\pm 1$  minute
- f. Off, 60 seconds,  $\pm 10$  seconds
- g. Repeat cycle, starting with (a).

The local control switch shall be manually cycled through the low, medium, and high intensity step positions a minimum of 20 times at the completion of the 150-hour test. When an alarm occurs during the conduct of the test, the test shall be discontinued and the cause of the alarm investigated. The test shall proceed only after the alarm has been cleared. If the REIL is designed with flash tubes, then the flash tubes used in the 150-hour test shall not be a part of the FAA procurement and shall be replaced with new flash tubes prior to system delivery.

4.4.12.2 The 2-hour test. The REIL system production units shall undergo a 2-hour continuous operational test using the remote control inputs as follows:

- a. High intensity, 1 hour  $\pm 2$  minutes
- b. Cycle in accordance with 4.4.12.1 (a) through (g), 1 hour  $\pm 2$  minutes.

The local control switch shall be manually cycled through the low, medium, and high intensity positions a minimum of 20 times at the completion of the 2-hour test.

4.4.13 Photometric test. Tests shall be conducted on the identifier unit to prove conformance with all photometric requirements. Determination of effective intensity shall be in accordance with FAA-E-1100.

4.4.14 Thermal shock test. The production model shall be installed as in normal use and operated at maximum intensity until the temperatures have stabilized. At least 3 gallons of water at a temperature of 0 to  $+5^{\circ}$  C ( $32^{\circ}$  to  $+41^{\circ}$  F) shall be sprayed on the top surface. There shall be no cracking of glass or metal.

4.4.15 Dielectric test. The production model shall be subjected to 60 hertz dielectric tests using twice circuit voltage plus 1,000 volts for a period of 1 minute. Any evidence of current leakage in excess of one milliamperere shall be cause for rejection. After completion of the dielectric test, a 1,000 V dc insulation tester shall be used to check the same points. The resistance to ground, as observed with the insulation tester, shall be not less than 30 megohms. Components not designed for this high voltage, such as small capacitors, rectifiers, etc., may

be disconnected for this test. Production units shall be checked with the insulation tester.

4.4.16 Maintainability demonstration tests. Maintainability demonstration tests shall be performed in accordance with MIL-HDBK-470 to verify all quantitative maintenance values required by the specification.

4.4.17 Site spare parts test. Spare printed circuit boards shall be tested as part of a unit and shall be subjected to the tests specified in Table IV, as applicable.

TABLE IV. Qualification and production tests

Test	Control Cabinet	Individual Control Cabinet	Identifier Unit	Aiming Device	Site Spare Parts
Visual Inspection (4.4.1)	X@*	X@*	X@*	X@*	X@*
Humidity (4.4.2)	X	X	X		
Altitude (4.4.3)	X	x	X		
Temperature (4.4.4)	X@	X@	X@		
Sand and Dust (4.4.5)	X	X	X		
Salt Spray (4.4.6)	X	X	X		
Rain (4.4.7)	X	X	X		
Solar Radiation (4.4.8)	X	X	X		
Vibration (4.4.9)	X@	X@	X@		
Transient Suppression (4.4.10)	X	X			
Interference (4.4.11)	X	X			
150-hour Test (4.4.12.1)	X@	X@	X@		
2-hour Test (4.4.12.2)	*	*	*		*
Photometric (4.4.13)			X@		
Thermal Shock (4.4.14)			X		
Dielectric (4.4.15)	X*	X*	X*		
Maintainability Demonstration (4.4.16)	X	X	X		

X = Design qualification test (first articles)

\* = Production unit test

@ = Type test of Production Unit

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 Deliverable items. The following items are called out in the Contractor documents as deliverable items under this specification:

- a. Control cabinet
- b. Identifier assemblies
- c. Site spare parts
- d. Instruction book(s).

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

6.3 Instruction books. The requirement for technical manuals should be considered when this specification is applied to a contract. If technical manuals are required, specifications and standards that have been determined necessary and justified through program management studies must be listed on a separate Contract Data Requirements List (DD Form 1423), which is included as an exhibit to the contract. The technical manuals must be acquired under separate contract line item in the contract, (see FAA-D-2494/b).

6.4 Definitions. The following definitions form a part of this specification.

6.4.1 Failure. The inability of any part, circuit assembly, unit, or group of units to operate within its normal and previously established operating tolerance shall constitute a failure. It shall be specifically noted that it is not necessary that a maintenance action be required or an equipment outage result because of a failure.

6.4.2 Module. A module is defined as being two or more basic parts which form a functional assembly, which is a portion of a larger assembly or unit. The module is easily removed intact and replaced by plug-in, unsoldering, "quick-disconnect" fastener, or equivalent means. It may or may not contain printed circuitry and it may contain active or passive devices.

6.4.3 Unit. The term unit is defined as a major building block for a group, set or system consisting of a collection of basic parts, subassemblies, assemblies mounted together on a single chassis, or packaged together as a physically independent entity.

## APPENDIX A

## Verification of requirements traceability matrix (VRTM)

REIL REQUIREMENT / VERIFICATION CROSS-REFERENCE MATRIX									
METHOD OF VERIFICATION					CLASSES OF VERIFICATION				
N/A - NOT APPLICABLE 1 - ANALYSIS 2 - DEMONSTRATION 3 - INSPECTION 4 - TEST					A - DESIGN VERIFICATION B - (RESERVED-DETAIL SPECIFICATION) C - (RESERVED-DETAIL SPECIFICATION)				
SECTION 3 REQUIREMENT	VERIFICATION METHOD					VERIFICATION CLASS			SECTION 4 VERIFICATION
	NA	1	2	3	4	A	B	C	
3.1	X								
3.2	X								
3.3				X					4.4.13
3.4			X			X			4.4.12.1 & .2
3.4.1				X		X			
3.4.1.1					X	X			
3.4.1.2					X	X			4.4.12
3.4.1.3					X	X			4.4.12
3.4.1.3.1			X		X	X			4.4.12
3.4.1.4				X					
3.4.1.5				X <sub>1-5, 13</sub>	X <sub>6-12</sub>	X			4.4.12.1
3.4.1.6				X					
3.4.1.7		X <sub>1</sub>		X <sub>1-4</sub>					
3.4.1.8					X				
3.4.1.9			X						
3.4.1.10				X					
3.4.1.11					X	X			4.4.10
3.4.1.12				X					
3.4.2				X					
3.4.2.1					X				
3.4.2.2				X					
3.4.2.2.1					X				
3.4.2.2.2				X					
3.4.2.2.3				X					
3.4.2.2.4				*X <sub>2-4</sub>	*X <sub>1</sub>				
3.4.2.2.5				X					
3.4.2.2.6					X				4.3.3, 4.4.13
3.4.2.3					X				
3.4.2.4				X					
3.4.2.5				X					
3.4.3				*X <sub>1-4</sub>	*X <sub>5</sub>				
3.5				X					
3.5.1					X	X			4.3.3, 4.4.4
3.5.2					X	X			4.4.3
3.5.3					X	X			4.4.2
3.5.4					X	X			4.4.5
3.5.5					X	X			4.4.6
3.5.6					X	X			4.4.7
3.5.7					X	X			4.4.8
3.5.8					X	X			4.3.3, 4.4.9
3.5.9					X	X			4.4.14
3.6					X	X			4.4.10
3.7					X	X			4.4.11
3.8	X								
3.8.1		X							

\* Subscript number refers to the "shall" statement in order of appearance in the referenced section.

## Verification of requirements traceability matrix (VRTM) - Continued

REIL REQUIREMENT / VERIFICATION CROSS-REFERENCE MATRIX									
METHOD OF VERIFICATION					CLASSES OF VERIFICATION				
N/A - NOT APPLICABLE 1 - ANALYSIS 2 - DEMONSTRATION 3 - INSPECTION 4 - TEST					A - DESIGN VERIFICATION B - (RESERVED-DETAIL SPECIFICATION) C - (RESERVED-DETAIL SPECIFICATION)				
SECTION 3 REQUIREMENT	VERIFICATION METHOD					VERIFICATION CLASS			SECTION 4 VERIFICATION
	NA	1	2	3	4	A	B	C	
3.9	X								
3.9.1					X	X			4.4.16
3.9.2			X	X					
3.10	X								
3.10.1					X	X			4.4.12
3.11					X	X			4.4.12
3.11.1				X					
3.11.2				X					
3.11.2.1				X					
3.11.2.2				X					
3.11.3				X					
3.11.3.1				X					
3.11.3.2				X					
3.11.3.3				X					
3.11.4					X				4.4.4
3.11.5				X					
3.11.6				X					
3.12	X								
3.12.1				X					
3.12.2				X					
3.12.3				X					
3.12.4				X					
3.12.5				X					
3.12.6				X					
3.12.7				X					
3.13				X					
3.14				X					
3.15				X					
3.16				X					
3.17				X					

\* Subscript number refers to the "shall" statement in order of appearance in the referenced section.

FAA-E-2159e

## APPENDIX B

## NAS-SS-1000 requirements trace

REIL REQUIREMENT / NAS-SS-1000 Requirements Trace			
NAS-SS-1000 Paragraph	Requirement Heading	FAA-E-2159E Paragraph	Comments
3.2.1.4.7	Runway-End Identifier Lights (REIL)	3.3	
3.2.1.4.7.1	Functional Characteristics	N/A	
3.2.1.4.7.1.1	Service	3.3	
3.2.1.4.7.1.2	Operational Control	3.3	
3.2.1.4.7.1.3	Radio Control	3.4.1.5	
3.2.1.4.7.1.4	Automatic Shutdown		Requirement is in L-854 receiver
3.2.1.4.7.1.5	Maintenance Monitoring		RMS Requirement
3.2.1.4.7.1.6	Maintenance and Status Data		RMS Requirement
3.2.1.4.7.2	Performance Characteristics	N/A	
3.2.1.4.7.2.1	Duration		Requirement is in L-854 receiver
3.2.1.4.7.2.2	Intensity	3.4.1.2	
3.2.1.4.7.2.3	Effective Range	3.3	
3.2.1.4.7.2.4	Link Control Unit		RMS Requirement
3.2.1.4.7.2.5	Maintenance Monitoring Performance Characteristics		RMS Requirement
3.2.1.4.7.3	Functional/Physical Interface		