RUNWAY STATUS LIGHTS SYSTEM

FEDERAL AVIATION ADMINISTRATION
AIRPORT ENGINEERING DIVISION

Engineering Brief #64A

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FIGURES

1. PURPOSE

The Federal Aviation Administration (FAA) is conducting a research and development project to determine the operational suitability of a system of runway status lights (RWSL) in the National Airspace System (NAS). RWSL is designed as an airport surface safety system to reduce runway incursions. This engineering brief defines the in-pavement lighting configurations for two components of a RWSL system. This EB-64A cancels EB-64.

2. SYSTEM DESCRIPTION

The RWSL system consists of two major subsystems:

- FAA AIRPORT GROUND SURVEILLANCE SYSTEM

  This subsystem is to be provided by FAA.

- Field Lighting Control System (FLCS)

  The FAA envisions the RWSL FLCS subsystem to be certified equipment meeting FAA standards in an Advisory Circular (AC) and to be made available by manufacturers for direct purchase by airport authorities. The details of this system will be provided in the future AC. The in-pavement lighting subsystem comprises two components – Runway Entrance Lights (REL) and Takeoff Hold Lights (THL) and associated constant current regulators and cabling.

3. INSTALLATION

The installation of RWSL systems must be in accordance with AC 150/5340-30, *Design and Installation Details for Airport Visual Aids.*

4. RUNWAY ENTRANCE LIGHTS (REL)

RELs are installed at taxiway/runway intersections (see Section 4 for a detailed diagram of the various REL configurations proposed) and warn aircrews or vehicles when it unsafe to cross or enter a runway. They are traffic red incandescent in-pavement light fixtures conforming to AC 150/5345-46, *Specification for Runway and Taxiway Light Fixtures,* Type L-852S. Additional fixture information and an example are shown below.

4.1. REL Mounting Base

The mounting base for REL in-pavement light fixtures will be similar to the example in Figure 1. Note the Individual Light Controller is also installed in the mounting base. Mounting bases will be type L-868, Class 1.

4.2. REL Configurations

The following standards apply for the Runway Entrance Light fixtures (Type L-852S) configurations:

- Basic Configuration (straight taxiway perpendicular to the runway)
- Angled Configuration (straight taxiway not perpendicular to the runway)
- Curved Configuration (curved taxiway at a varying angle to the runway)

RELs are installed parallel to the taxiway centerline as shown in Figure 3. RELs are spaced laterally 2 feet from the taxiway centerline, on the opposite side of taxiway centerline lights (if installed). The first light in the pattern is installed 2 feet prior to the runway holding position marking. Longitudinal spacing must conform to the standards detailed in Table 4.1 of AC 150/5340-30. The penultimate light is installed 2 feet prior to the runway edge stripe, and the last light is installed 2 feet to the side of the runway centerline lights toward the intersecting taxiway.

4.2.1. Basic (90-degree) configuration.

This is the most common and simplest form of intersection. Since the taxiway centerline is perpendicular to the runway centerline, the longitudinal line of RELs is also perpendicular to the runway, and all the lights are aimed along the taxiway path, that is perpendicular to the runway centerline.

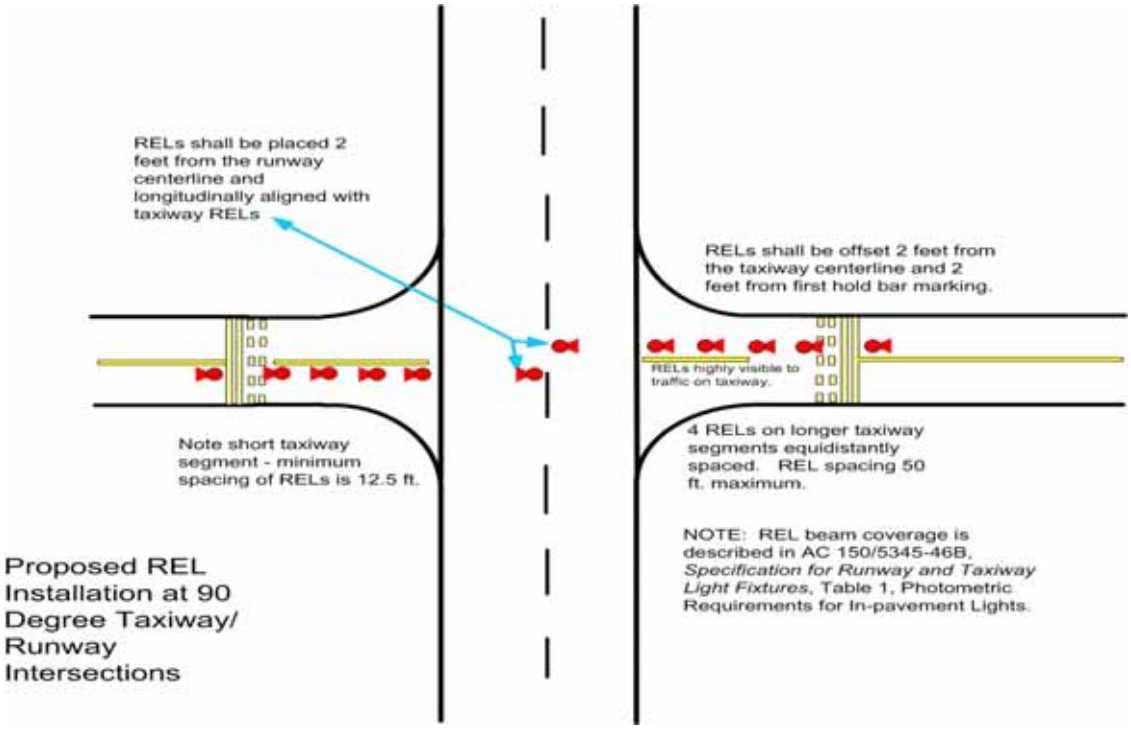
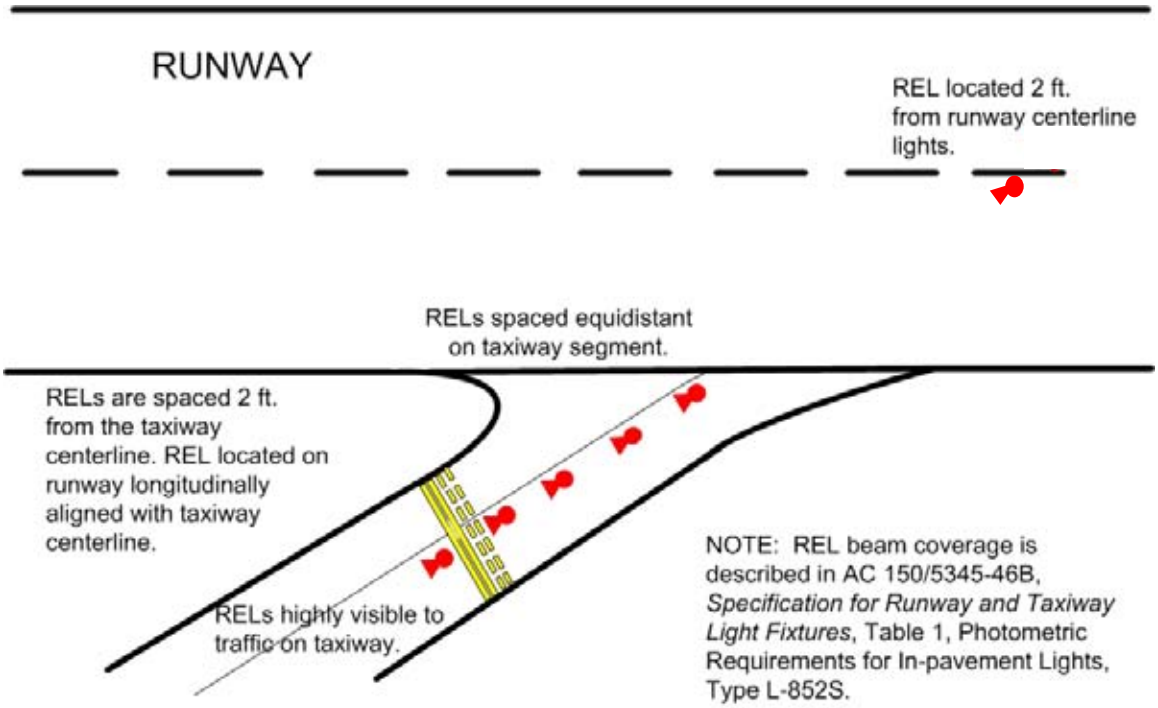


Figure 1. Basic Configuration

4.2.2. Angled Configuration.

This configuration is used where the intersecting taxiway is not perpendicular to the runway centerline but not less than 60 degrees from the runway centerline. The location and spacing of the REL lights along the taxiway centerline is identical to the one used on perpendicular intersections. For highly angled taxiways (e.g. less than 60 degrees from the runway centerline heading), the fixtures used and aiming will be determined on a case by case basis. Contact AAS-100 for specific guidance.



Angled Configuration (Straight Taxiway Not Perpendicular to Runway.)

Figure 2. Angled Configuration

4.2.3. Curved Configuration.

When the taxiway centerline marking between the holding position marking and the runway is curved, longitudinal spacing must comply with the standards in AC 150/5340-30 for taxiway centerline lights. The runway centerline REL will be located on the extended line of the last two longitudinal lights near the runway edge. Where a tangent to the curve of the taxiway centerline intersects the

runway centerline at not less than 60 degrees, aiming will comply with AC 150/5340-30 for taxiway centerline lights. When the angle is less than 60 degrees, aiming will be determined on a case-by-case basis. Contact AAS-100 for specific guidance.

5. TAKEOFF HOLD LIGHTS (THL)

THLs are used at the runway departure area to warn aircrews and vehicle operators the runway is unsafe for takeoff. They are red unidirectional lights that are installed in a double longitudinal row aligned and offset 6 feet from either side of the runway centerline lighting at a longitudinal spacing of 100 feet. THLs begin at a point 375 feet from the runway threshold and continue for a minimum of 1500 feet down the runway. The actual length of the system will be determined on a case-by-case basis. See Section 6.1 for a more detailed runway location description and diagrams.

THLs use type L-850A fixtures with a 105 Watt (modified) filament, Class 2, Style 3 semi-flush fixtures.

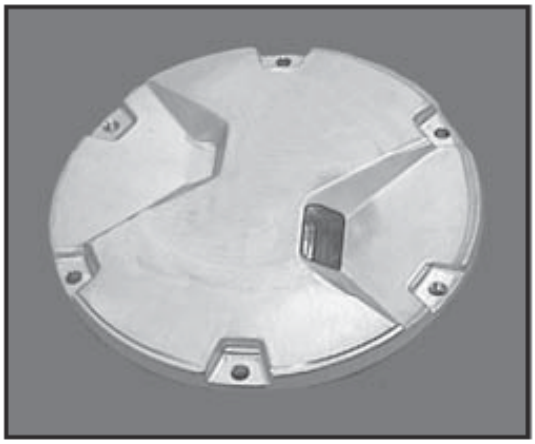


Figure 3. Modified Type L-850A Light

5.1. THL Mounting Base

THL mounting bases are identical to those used for RELs - see Figure 1.

5.2. General Installation.

See Figure 5 below. THLs are a double row of in-pavement red lights (modified L-850A), aligned with the runway centerline lights aimed toward the approach path to the runway. They begin at a point that is 375 feet from the runway threshold and are displaced 6 feet either side of the runway centerline lights. THLs are placed every 100 feet for a 50 foot spaced centerline - between the centerline lights in every other

space. There will be a minimum of 1500 feet of lights (32 lights) in the array. The total length of the system is determined on a case-by-case basis.

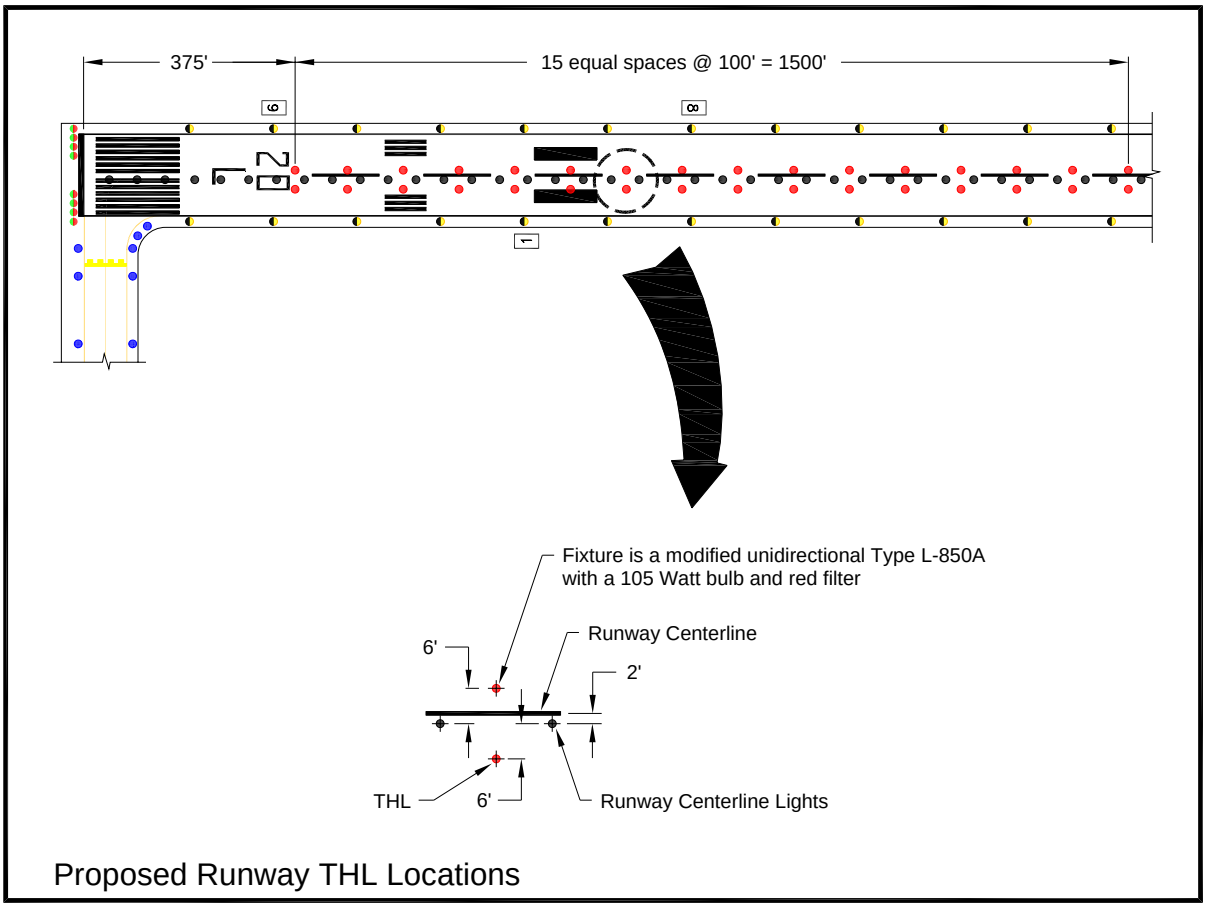


Figure 4. Takeoff/Hold Lights

5.3. Constant Current Regulator Power Supply

This unit provides constant current power to all RWSL lamps (via the lighting cable) and is interfaced to the FLCS Master. The CCR is an FAA Type L-828 (no monitoring) Class 1 (6.6 Amps) per AC 150/5345-10, *Specification for Constant Current Regulators/Regulator Monitors.*

5.4. Isolation Transformer

The isolation transformer connects the individual light control (ILC) to the field lighting power cable. The use of an isolation transformer reduces the potential for an open individual lamp circuit fault to cause damage to the resonant CCR distribution system.

The isolation transformers are per: AC-150/5345-47, *Isolation Transformers for Airport Lighting Systems:* FAA Type L-830-4, 6.6 A, 100 watts (W), 60 Hertz (Hz) for THLs and RELs.

5.5. Individual Light Controller (ILC)

The ILC input connects to the secondary side of the isolation transformer. Master lamp control data (power line carrier serial data) is coupled through the isolation transformer from the high voltage primary to secondary windings, demodulated by the RF MODEM, and passed to the processor. The ILC connects to the lamp filaments via the Lamp Switching Circuits and Components section that employs both electro-mechanical and solid state switching devices. Each ILC is assigned a unique serial address that enables the computer control of individual airfield lights:

- Lamp ON or OFF.
- Predefined fail-safe settings - ON/OFF/Flashing (The flashing function is not used in RWSL).

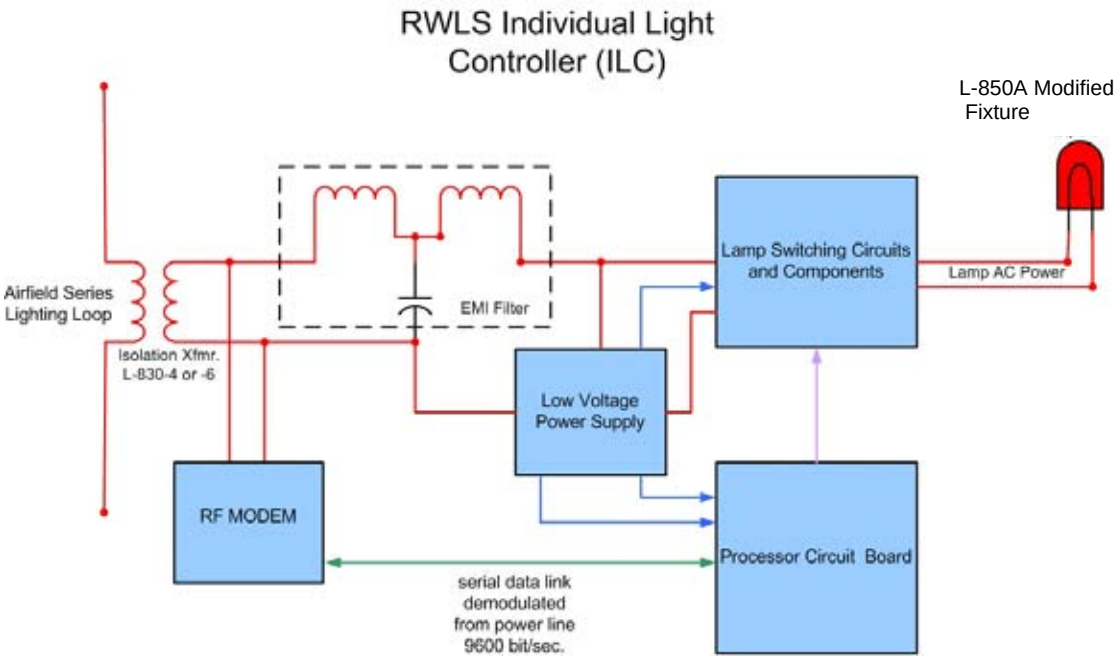


Figure 5. ILC

The ILC also provides monitoring of lamp current, voltage, and load status, including a lamp out detection when it is not processing commands. If a lamp fails, the ILC places a short across the secondary side of the isolation transformer to maintain light system loading.

6. DESIGN

6.1. General Guidelines

The RWSL will be installed using new conduit where possible for existing runways/taxiways. Future installations of in-pavement L-868B light bases and conduit should be done, if possible, while the pavement is under construction or when an overlay is made. Installation of conduit and light bases after paving is very costly and requires a lengthy shutdown of the taxiway or runway.

6.2. Layout

A design drawing must be developed prior to construction, showing the dimensional layout of each lighting system to be installed. It is preferable to use dedicated conduits and duct banks to reduce the possibility of potential interference with existing systems. However, this may not be possible at all RWSL installations. In the instances where dedicated conduits and duct banks cannot be used, correlate the intended design with current airport drawings to utilize available ducts and utilities and to avoid conflict with existing or planned facilities.

6.3. In-Pavement Light Fixtures and Electrical Cables

Design each in-pavement lighting system for one of the conditions listed below:

6.3.1. New Rigid and Flexible Pavements

THL and REL fixtures installed in new pavement must be designed for installation into L-868 load bearing light bases in accordance with AC 150/5345-42, *Specification for Airport Light Bases, Transformer Housings, Junction Boxes, and Accessories.* An isolation transformer in accordance with AC 150/5345-47, *Isolation Transformers for Airport Lighting Systems,* must be provided for each light. See AC 150/5340-30, Design and Installation Details for Airport Visual Aids, for drawings and guidance regarding the installation of light bases and conduit.

In-pavement RELs and THLs will be either: 1) direct-mounted light fixtures (Class 1 per AC 150/5345-46, Specification for Runway and Taxiway Light Fixtures) with wire connections made in junction boxes or, 2) installed on L-868 bases (Class 2 light fixtures per AC 150/5345-46) with wire connections made in the bases. See AC 150/5340-30 detailed drawings and guidance regarding the installation of direct mounted fixtures.

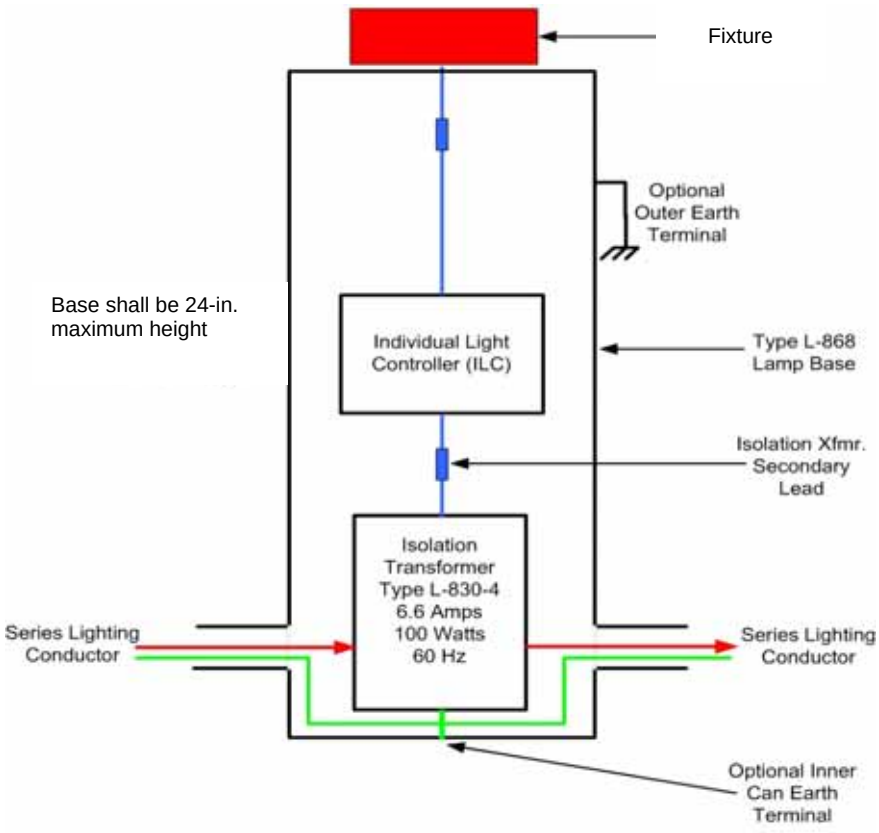


Figure 6. REL Mounting Base Detail

6.3.2. Overlay Rigid and Flexible Pavements

A base and conduit system described in 6.3.1, above, may be used. Two-section bases and spacer rings to reach proper elevation may be required. See AC 150/5340-30 for installation guidance and information.

6.3.3. Existing Pavements

Provide recesses or holes for direct-mounted light fixtures or fixtures installed on bases. Isolation transformers and local control devices are located at the side of the taxiway. Only one taxiway hold light or runway entrance light may be operated from a single L-830-4, 6.6 A, 100 W isolation transformer. See AC 150/5340-30 drawings and installation guidance for wiring kerfs, wiring and junction box locations.

Alternatively, L-868B bases and conduit systems for THL and REL systems may be retrofitted into existing pavements. Isolation transformers and/or local control devices are located within the bases.

6.4. SMGCS

Any potential impacts of the RWSL system on airport SMGCS operation must be evaluated and resolved prior to commencing any installation activities at that airport. (Need to give coordination details here)

6.5. Takeoff Hold and Runway Entrance Lighting Systems

6.5.1. Fixture Selection

L-852S, Class 2, Style 3, Mode 1 fixtures will be installed on taxiways, and L-850A, Class 2, Style 3, 105W (modified) on runways that are designated for RWSL systems.

6.5.2. Power Supply

Series circuits for THL and REL systems will be powered with separate, dedicated constant current regulators in accordance with AC-5345-10E, *Specification for Constant Current Regulators and Regulator Monitors.*

6.5.3. THL and REL Control Methods

6.5.3.1. General

Where possible, simple switching to energize and de-energize the circuits or to control lamp brightness will be used.

6.5.3.2. Control System & Electromagnetic Interference (EMI)

The airport design engineer is responsible for ensuring that the FLCS control system is reliable and electromagnetic interference does not cause unintended switching of the RWSL lighting system. In addition, the FLCS control system must cause minimal radiated or conducted electromagnetic interference to other FAA equipment on or near the airport.

6.5.3.3. 120 Volts AC

Where the distance between the remote control panel and the vault is not great enough to cause excessive voltage drop in the control leads, use standard control panel switches to operate the control relays directly. Operating relays supplying power to the taxiway centerline regulators must have coils rated for 120 volts AC. A No. 12 AWG control cable should be used to connect the control panel to the power supply equipment in the vault.

7. EQUIPMENT AND MATERIAL

7.1. General

Equipment and material used in the RWSL system listed below will conform to the AC or specification indicated, and must be listed in the addendum to AC 150/5345-53, *Airport Lighting Equipment Certification Program.*

ACs and specifications are referenced by number and title in Appendix B.

Equipment and Material Used for RWSL Systems

Equipment and Material	Advisory Circulars
L-850A Light Fixtures	AC 150/5345-46
L-852S Light Fixtures	AC 150/5345-46
L-847 Circuit Selector Switch	AC 150/5345-5
L-824 No. 8 AWG Cable	AC 150/5345-7
L-824 No. 10 AWG THWN Cable	AC 150/5345-7
L-824 No. 12 AWG Cable	AC 150/5345-7
L-828 Constant Current Regulator	AC 150/5345-l0
L-823 Connectors	AC 150/5345-26
L-868 Bases	AC 150/5345-42
L-869 Junction Box	AC 150/5345-42
L-830 Isolation Transformer	AC 150/5345-47
L-108 Counterpoise Cable	AC 150/5370-10
L-109 Transformer Vault	AC 150/5370-10
L-110 Conduit and Duct	AC 150/5370-10
P-605 Joint Sealer, Type III	AC 150/5370-10
P-606 Sealer Material (Liquid and Paste)	AC 150/5370-10
P-610 Concrete Backfill	AC 150/5370-10

7.2. Vault

The vault must be of the type shown on the design plans. Construction is to be reinforced concrete, concrete masonry, brick wall, or prefabricated steel, as specified. Use of distribution transformers, oil switches, cutouts, and all regularly used commercial items of equipment not covered by FAA specifications must conform to applicable standards of the electrical industry.

7.3. Light Base and Transformer Housing

Use a base and transformer housing conforming to AC 150/5345-42C, *Specification for Airport Light Bases, Transformer Houses, Junction Boxes and Accessories*. If the secondary wires are fed to the in-pavement lights through a saw kerf, a one-inch hub is

welded to the base at 90 degrees from the two existing two-inch hubs that are 180 degrees apart. A gasket and suitable cover are also required for off-taxiway installation.

7.4. Pre-insulated Connectors

When splicing the fixture leads to the No. 10 AWG type THWN wires, use pre-insulated connectors suitable for installation in the wire ways in accordance with AC 150/5345-26C, *Specification for L-823 Plug and Receptacle, Cable Connectors.*

7.5. Optional Sealer Material

Other types of sealer material that provide satisfactory adhesive and waterproofing qualities may be used in lieu of sealer materials P-605 and P-606, upon approval of the airport engineer in charge. Any sealer to be used with asphalt pavements must be compatible.

8. OPERATIONAL TESTING

8.1. General

Before connecting and energizing the regulator, make a 24-hour recording of the primary input voltage to determine which regulator voltage tap to use. If the maximum input voltage exceeds the 480-volt maximum tap, correct the input voltage. Install lamps in all light fixtures for check out. Note: Operations with excessive open isolation transformer loads can damage a monocyclic type resonant circuit regulator. A short will be placed at the ILC.

8.2. Open-Circuit Protection

Check the open-circuit protective device only once, then allow a five-minute cooling period before rechecking. Continuous cycling of the protective device can overheat and burn out the thermal relay.

8.3. Complete System Operation

Test the installation by continuous operation for not less than one-half hour as a complete system including the functioning of each control not less than ten times. Test the completed circuits in accordance with the applicable provisions of Item L-108.

8.4. Transformer and Feeder Fusing

Check to determine the primary (high voltage) fuses for transformers and feeders do not exceed 200 percent of the rating of the transformer. Secondary (low voltage) fuses for transformers and feeders must not exceed 125 percent of the transformer rating.

8.5. Vault Equipment

Test the vault equipment specified in Item L-109 and AFLC system components manufacturer's recommendation. Include a check to determine that the resistance to ground of any part of the grounding system will not exceed 10 ohms.

8.6. Equipment

Subject all regulators and other applicable equipment to performance tests specified in the manufacturer's instructions.

8.7. Cables, Wiring and Splices

Check all cables, wiring, and splices to obtain assurance the installation is in accordance with Item L-108. Check underground cables and wire in saw kerfs before the installation is completed.

8.8. Ducts and Duct Markers

Ensure that all ducts and duct markers are installed in accordance with Item L-110. Check underground ducts before installation is completed.

9. REFERENCES

RWSL Research Management Plan, Version 2.0, dated December 2002

RWSL Systems Requirements Document, Revision 2.3, dated February 21, 2002

Operational Concept Document for RWSL, dated January 29, 2002

RWSL Human Factors Study, v5.5c3 Runway Entrance Light (REL) Configuration, dated May 21, 2003

FAA-STD 020b, *Transient Protection, Grounding, Bonding and Shielding Requirements for Electronic Equipment*, dated May 11, 1992

RWSL OpEval Plan, TBA

RWSL Human Factors Plan, TBA

NOTAMS, TBA

10. ACRONYMS

AC	Advisory Circular
ADO	Airports District Office
AFLC	Airfield Lighting Computer
AMASS	Airport Movement Safety System (part of ASDE-3)
ASDE-3	Airport Surface Detection Equipment – 3
ASDE-X	Airport Surface Detection Equipment – X
AWG	American Wire Gauge
BRITE	Siemens proprietary second generation individual lamp control/monitoring
BOS	Boston/Logan International Airport
CCR	Constant Current Regulator
DFW	Dallas Ft. Worth International Airport
DOT	Department of Transportation
FAA	Federal Aviation Administration
FLCS	Field Lighting Control System
Hz	Hertz
ILC	Individual Light Controller
LCC	Light Control Computer
MALSR	Medium Intensity Approach Lighting System
MIT/LL	Massachusetts Institute of Technology/Lincoln Lab
MLAT	Multilateration
MODEM	Modulator/Demodulator
NAS	National Airspace System

NTSB	National Transportation Safety Board
REL	Runway Entrance Lights
RF	Radio Frequency
RWSL	Runway Status Lights system
RWY/TWY	Runway/Taxiway
SAN	San Diego International Airport
SMGCS	Surface Movement Guidance and Control System
SMR	Surface Movement Radar
SPDT	Single Pole Double Throw
TDZ	Touchdown Zone
THL	Takeoff Hold Lights
W	Watt
XFMR	Isolation Transformer

11. LIST OF ADVISORY CIRCULARS

AC 120-57, *Surface Movement Guidance and Control System (SMGCS).*

AC 150/5000-13, *Announcement of Availability--RTCA Inc., Document RTCA-221, Guidance and Recommended Requirements for Airport Surface Movement Sensors.*

AC 150/5200-30, *Airport Winter Safety and Operations.*

AC 150/5300-13, *Airport Design.*

AC 150/5340-26, *Maintenance of Airport Visual Aid Facilities.*

AC 150/5345-3, *Specification for L-821 Airport Lighting Panels for Remote Control of Airport Lighting.*

AC 150/5345-5, *Circuit Selector Switch.*

AC 150/5345-7, *Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits*.

AC 150/5345-10, *Specification for Constant Current Regulators and Regulator Monitors*.

AC 150/5345-13, *Specification for L-841 Auxiliary Relay Cabinet Assembly for Pilot Control of Airport Lighting Circuits*.

AC 150/5345-26, *Specification for L-823 Plug and Receptacle, Cable Connectors*.

AC 150/5345-42, *Specification for Airport Light Bases, Transformer Housings, Junction Boxes, and Accessories*.

AC 150/5345-46, *Specification for Runway and Taxiway Light Fixtures*.

AC 150/5345-47, *Isolation Transformers for Airport Lighting Systems*.

AC 150/5345-53, *Airport Lighting Equipment Certification Program.*

AC 150/5370-10, *Standards for Specifying Construction of Airports*.