MEDIUM INTENSITY RUNWAY LIGHTING SYSTEM AND VISUAL APPROACH SLOPE INDICATORS FOR UTILITY AIRPORTS

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

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ADVISORY CIRCULAR

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

SUBJECT: MEDIUM INTENSITY RUNWAY LIGHTING SYSTEM AND VISUAL APPROACH SLOPE INDICATORS FOR UTILITY AIRPORTS

1. PURPOSE. This advisory circular describes standards for the design, installation, and maintenance of medium intensity runway lighting systems (MIRL), and visual approach slope indicators for utility airports.

2. CANCELLATION. AC 150/5340-16A, Medium Intensity Runway Lighting System, dated 19 December 1967.

3. REFERENCES. The publications listed under Appendix 1, Bibliography, are applicable to this advisory circular.

4. EXPLANATION OF REVISION. In addition to minor changes in the text, the following changes have been made:

   a. Details added regarding visual approach slope indicators at utility airports with medium intensity runway edge lights.

   b. Selection considerations added for MIRL and visual approach slope indicators.

   c. A typical drawing of a vault detail was deleted.

5. HOW TO OBTAIN THIS PUBLICATION. Obtain additional copies of this circular, AC 150/5340-16B, Medium Intensity Runway Lighting System and Visual Approach Slope Indicators for Utility Airports, from the Department of Transportation Distribution Unit, TAD-484.3, Washington, D. C. 20590.

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Initiated by: AS-580

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1. INTRODUCTION

a. Medium intensity runway lights (MIRL) are used to outline the edges of runways during periods or darkness and low visibility conditions. The lights are elevated units with an asymmetrical lens. The fixtures outlining the lateral limits of the runway emit aviation white light, whereas, those lights marking the longitudinal limits of this area emit aviation green light.

b. The MIRL may be supplemented with SAVASI or 2-Box visual approach slope indicators (VASI-2). Selection considerations are contained in paragraph 2.

2. SELECTION CONSIDERATIONS. The selection of a particular visual aid should be based on the operational needs of the runway. Apply the following guidelines when selecting MIRL, SAVASI, or VASI-2.

a. MIRL.

(1) Select MIRL for runways with day and night visual flight rules (VFR) operating minimums.

(2) Select MIRL for new locations with day and night instrument flight rules (IFR) operating minimums, unless runway visual range (RVR), or Category D aircraft are programmed within five years. In the latter cases, high intensity runway edge lights should be installed. See AC 150/5340-13A for details pertaining to high intensity runway edge lights.

(3) MIRL, where currently installed, and utilized in conjunction with an instrument landing system (ILS) and an approved approach light system, such as medium intensity approach lights with runway alignment indicator lights (MALSR), could provide visibility minimums as low as one-half mile for Category A, B, and C, aircraft. This includes two-and three-engine jets and the Lear 25 jet, and as low as three-fourths mile for Category D aircraft including four-engine jets.

b. SAVASI AND VASI-2

(1) The SAVASI, with a single lamp in each unit, is required at utility airports where there is a need to limit the load in the lighting circuit. The VASI-2 with three lamps in each unit must be selected if electrical capacity is not a problem, since

it has growth potential to the four-box VASI (VASI-4). The VASI-2 is required if electrical capacity is not a problem. See AC 150/5340-14B for details pertaining to VASI-2 and VASI-4.

(2) Select VASI-2 or SAVASI for installation as a training aid for student pilots. Use information in paragraph (1) above to obtain guidelines.

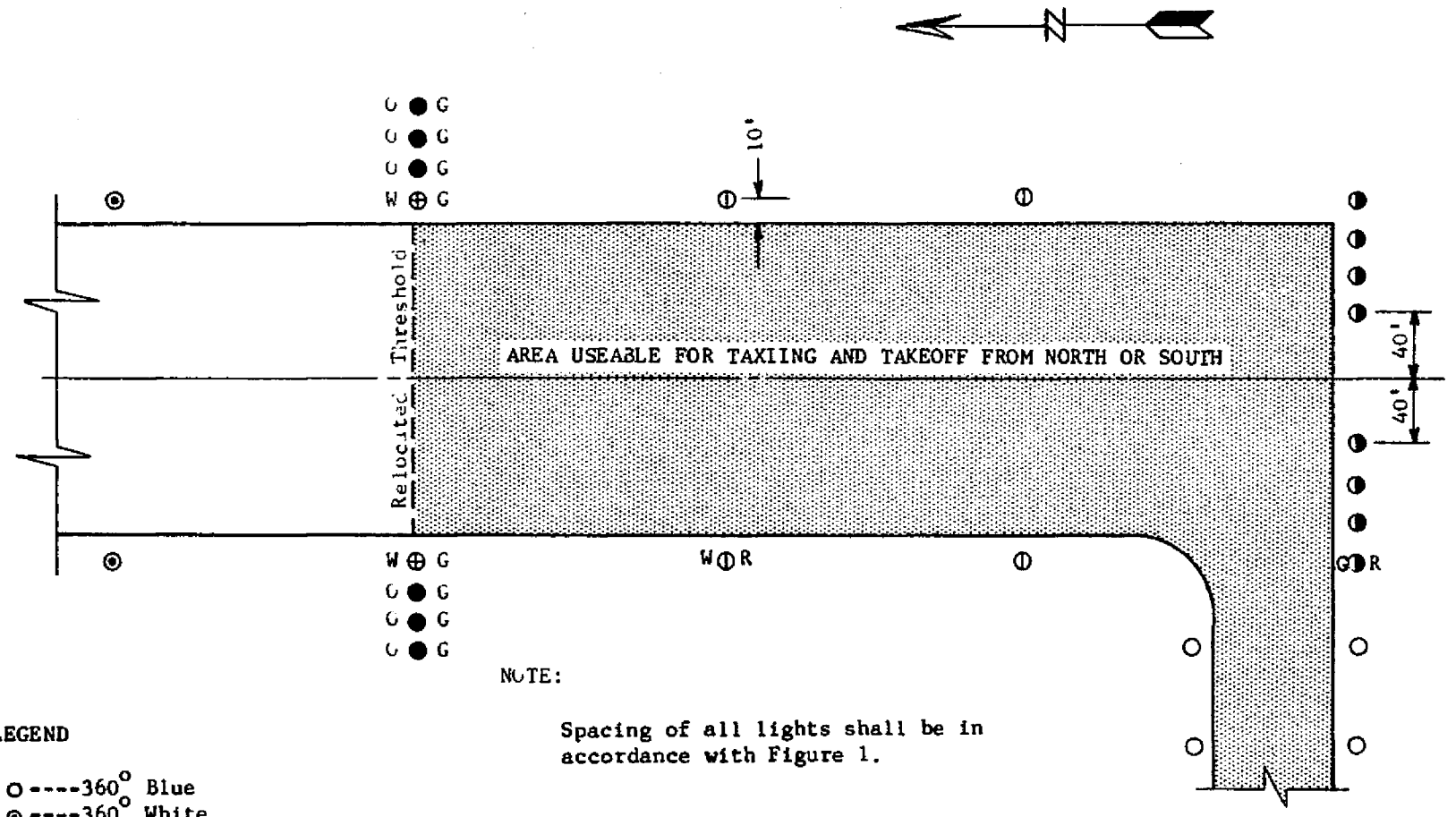
3. CONFIGURATION. Use the following basic requirements for MIRL and visual approach slope indicators.

a. Edge Lights. Install the edge lights along the full length of each side of the runway equidistant from and parallel to the runway centerline. Locate the light fixtures 10 feet maximum, (lateral spacing) from the full strength pavement designated for runway use. Space the edge lights 200 feet maximum in a longitudinal direction. Locate each light on one side of the runway with respect to its companion light on the opposite side so that a line joining the two will be at right angles to the runway centerline. Uniformly space the elevated lights within the individual sections of the runway resulting from consecutive intersection and runway ends and intersections. Add single elevated lights to avoid large gaps where the matching of lights on opposite sides of the runway cannot be accomplished. A gap in excess of 400 feet is considered large. If large gaps cannot be prevented, install the single lights as close as permitted to the intersecting pavement. See Figure 1 for typical configurations.

b. Threshold Lights.

(1) Locate the threshold lights on a line 2 feet, plus eight feet, minus zero feet, from the designated threshold of the runway. If a situation exists that makes the installation of the lights between the specified limits impractical, install the threshold lights not more than 50 feet from the designated threshold of the runway. The designated threshold is the end of the pavement useful for aircraft operations.

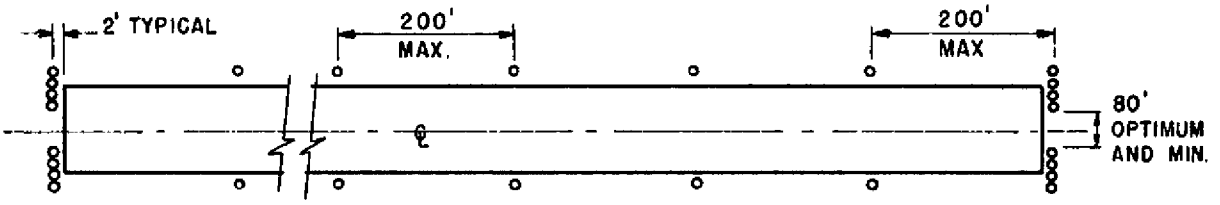
(2) Use two groups of lights located symmetrically about the runway centerline. Each group contains not less than four lights uniformly spaced if the runway width is 100 feet or greater. In this case, provide an optimum and minimum 80-foot gap between the two groups of lights. If the runway width is less than 100 feet, provide in each group, not less than three lights uniformly spaced. Use an optimum and minimum gap of 40 feet between the two groups of lights when the runway width is less than 100 feet. In either of the above cases, the outermost threshold light in each group is located in line with the rows of runway edge lights.



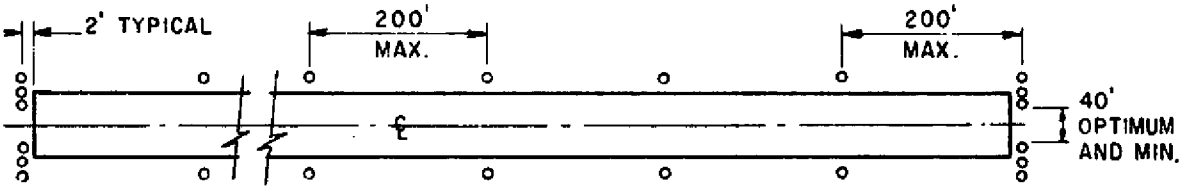
LEGEND

- O ----360° Blue
- ◎ ----360° White
- W◑R---180° White and 180° Red
- G◑R---180° Green and 180° Red
- O●G---180° Obscured and 180° Green
- W⊕G---180° White and 180° Green

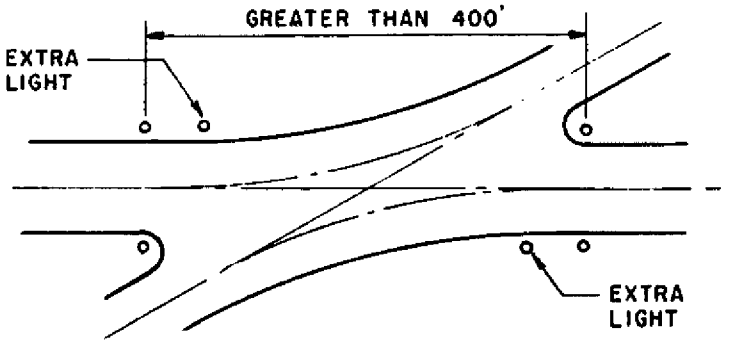
FIGURE 3b. RELOCATED THRESHOLD-AREA USEABLE FOR TAXIING AND TAKEOFF FROM NORTH OR SOUTH



a. RUNWAY WIDTH 100 FEET OR GREATER



b. RUNWAY WIDTH LESS THAN 100 FEET



c. LARGE GAP

FIGURE 1. RUNWAY AND THRESHOLD LIGHTING CONFIGURATIONS

c. Relocated Threshold.

(1) The lighting of relocated or displaced thresholds involves more than relocating lights. Consider all phases of operations on a runway before determining the lighting requirements.

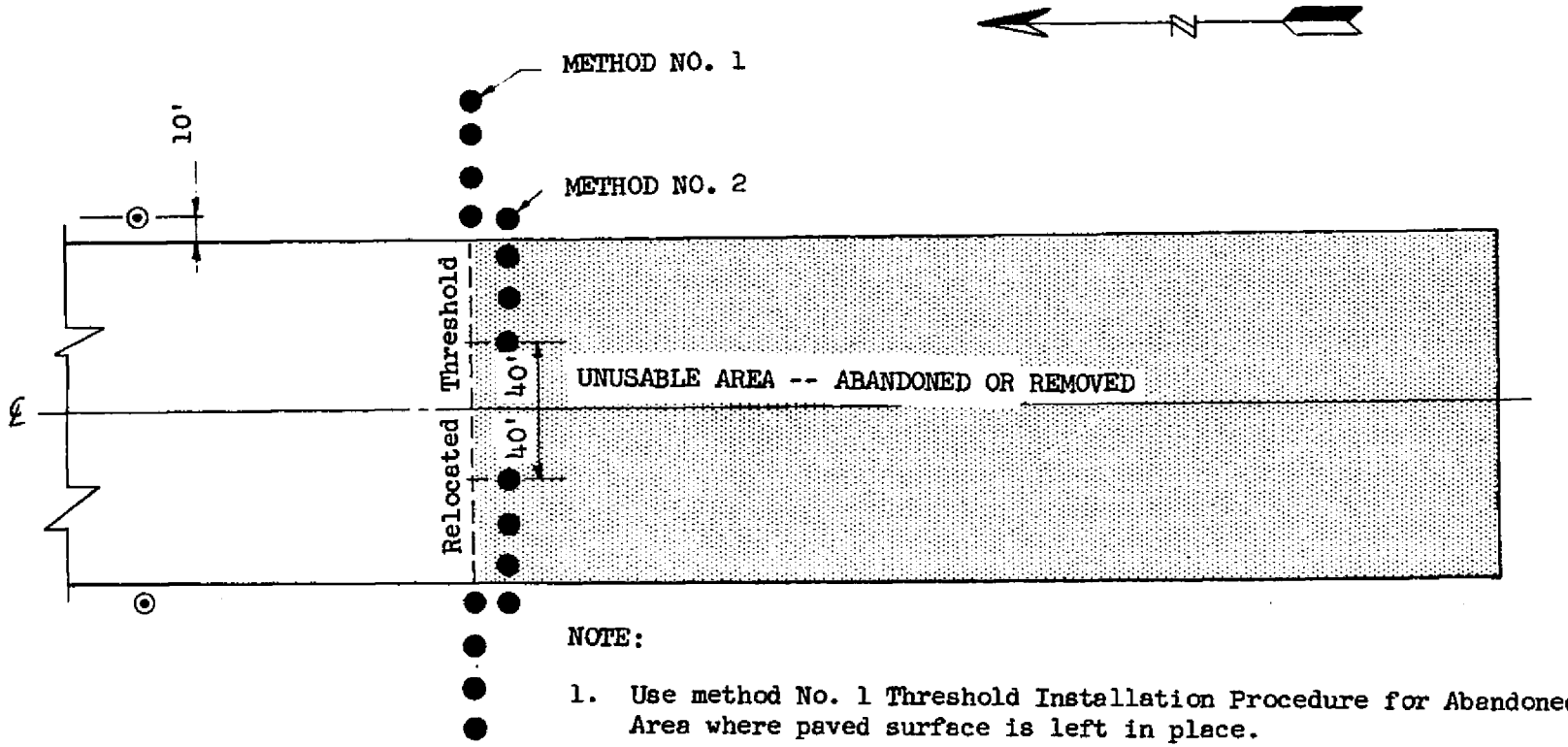
(2) When the threshold is displaced from the extremity of the runway, use a line of lights outboarded on each side of the runway. Extend these lights to an optimum distance of 40 feet outward from and at right angles to the line of runway edge lights. If the area created by the displaced threshold is useable for specific operations (takeoff only, taxiing) and denied for others, light the area to indicate the correct signal to the pilot for the operation. Light denied and unuseable areas by adding split, colored filters and/or blank portions of the light fixtures. The fixtures must indicate a green signal at the threshold area, a red signal for denied areas, a white signal for useable runway areas, and a blue signal for useable taxiing areas. See Figures 2, 3a, and 3b, for typical examples.

d. Runway/Taxiway Intersections. The configuration of taxiway lights at runway intersection shall be in accordance with AC 150/5340-15A.

e. Visual Approach Slope Indicators.

(1) VASI-2. See AC 150/5340-14B for configuration and aiming criteria for the standard 2-box visual approach slope indicator system.

(2) SAVASI. Provide two light units located 30 feet from the left runway edge when the optical system is viewed from the approach zone. Install the light units in a line parallel with the runway edge. Each light unit emits a two-color (red and white) light beam. When the light units are properly aimed, the optical systems provide visual approach slope information. When airport paved surfaces prevent the normal left side installation, or when significant cost reductions can be realized, install the system on the right side of the runway and publish this fact in the Airman's Information Manual. See Figure 4 for configuration and aiming criteria.



NOTE:

1. Use method No. 1 Threshold Installation Procedure for Abandoned Area where paved surface is left in place.

2. Use Method No. 2 Threshold Installation Procedure for Abandoned Area where paved surface has been removed.

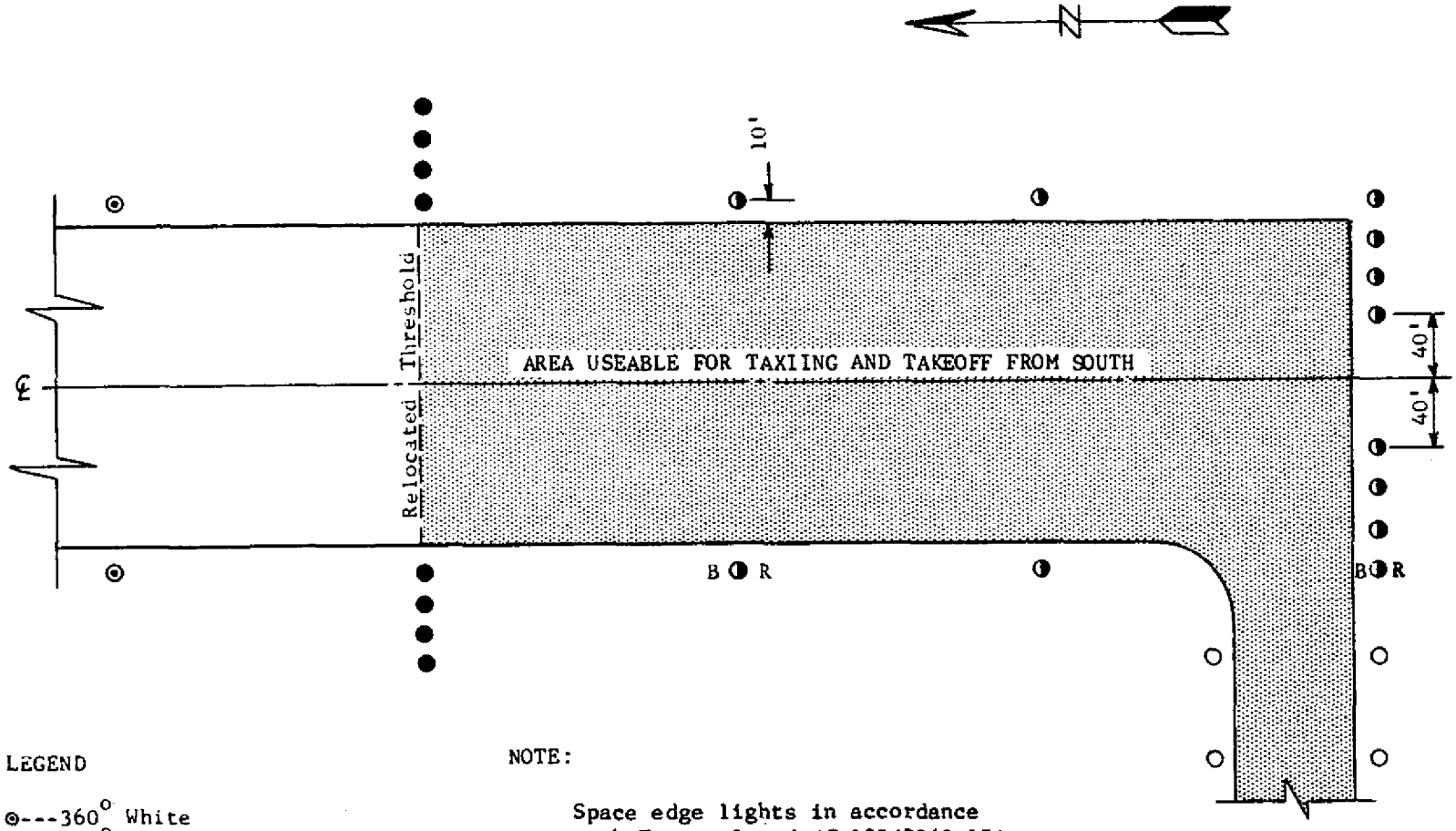
3. Space edge lights in accordance with Figure 1.

LEGEND

⊙--- 360° White

●---- 360° Green

FIGURE 2. RELOCATED THRESHOLD-UNUSEABLE AREA ABANDONED OR REMOVED



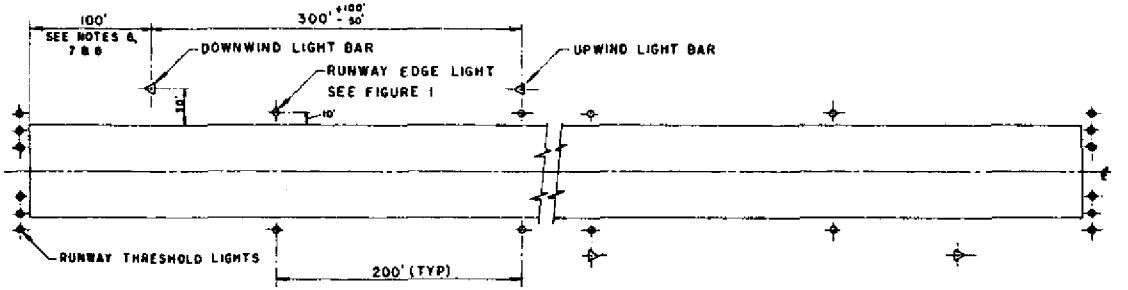
LEGEND

⊙---360° White
●---360° Green
B R--180° Blue and 180° Red
○---360° Blue

NOTE:

Space edge lights in accordance with Figure 1 and AC 150/5340-15A.

FIGURE 3a. RELOCATED THRESHOLD-AREA USEABLE FOR TAXIING AND TAKEOFF FROM SOUTH



DETAIL A- TYPICAL LAYOUT FOR UTILITY AIRPORT

LEGEND

ANGLE B - EFFECTIVE VISUAL APPROACH SLOPE OF SYSTEM.

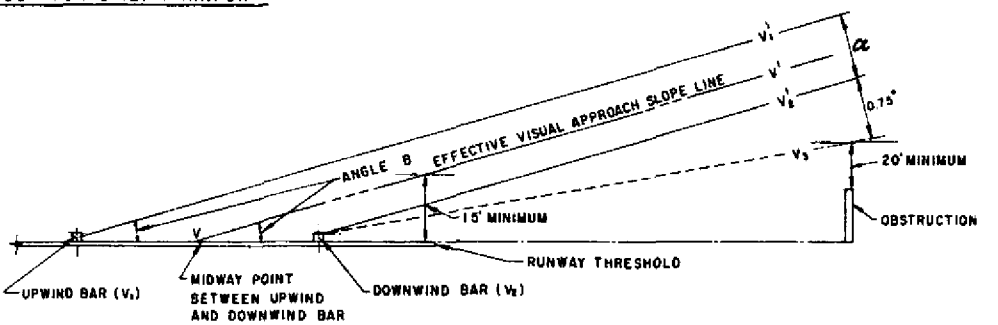
V - V' - EFFECTIVE VISUAL APPROACH SLOPE LINE.

$V_1 - V_1'$ - AIMING LINE OF UPWIND BAR.

$V_2 - V_2'$ - AIMING LINE OF DOWNWIND BAR.

$V_3 - V_3$ - APPROACH CLEARANCE SURFACE LINE.

APPROACH SLOPE LINE $V_2 - V_2'$ DIVERGES AT AN ANGULAR DIFFERENCE OF 0.6° FROM LINE $V_1 - V_1'$ $\alpha = 0.6°$

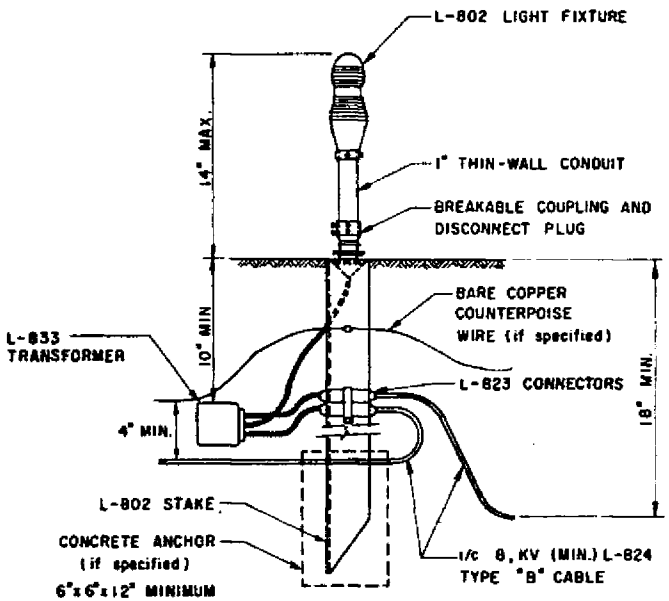


DETAIL B- AIMING CRITERIA

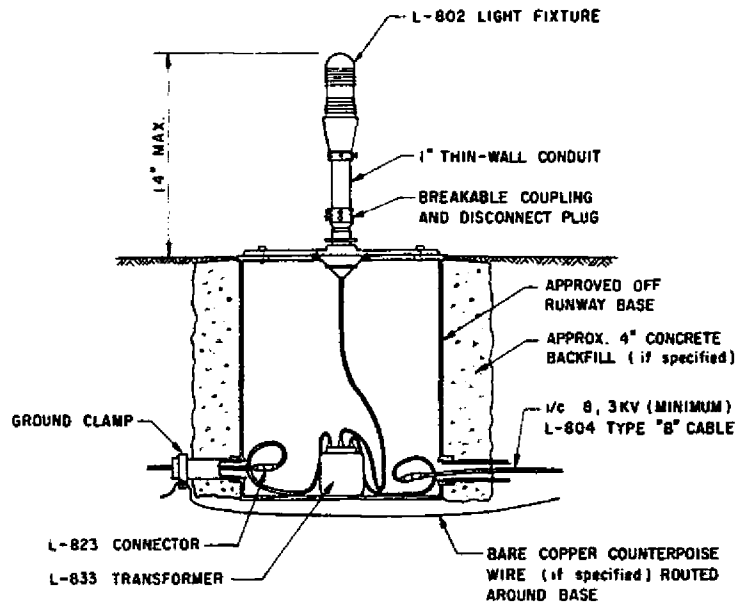
NOTES:

1. LOCATE THE UPWIND AND DOWNWIND LIGHT UNITS AT THE SAME DISTANCE FROM THE RUNWAY EDGE AND PREFERABLY ON THE LEFT SIDE OF THE RUNWAY. USE RIGHT SIDE INSTALLATIONS WHERE TAXIWAYS INTERSECT RUNWAYS NEAR THE THRESHOLD ON THE LEFT SIDE.
2. INSTALL THE CENTER OF THE OPTICAL APERTURE OF THE DOWNWIND AND UPWIND LIGHT UNITS WITHIN PLUS OR MINUS ONE FOOT OF THE RUNWAY CROWN.
3. LIGHT AND MARK ALL OBSTRUCTIONS, AS REQUIRED.
4. AIM THE DOWNWIND AND UPWIND LIGHT UNITS IN ACCORDANCE WITH EQUIPMENT MANFACTURER'S INSTRUCTIONS WITHIN PLUS OR MINUS 2 MINUTES OF THE RESPECTIVE ANGLES FORMED BY LINE $V_2 - V_2'$ AND THE RUNWAY SURFACE, AND LINE $V_1 - V_1'$ AND A HORIZONTAL PLANE.
5. DETERMINE THE EFFECTIVE VISUAL APPROACH SLOPE OF THE SYSTEM BY THE STEPS LISTED:
   A. MAKE A PLOT OF THE APPROACH AREA SHOWING THE LOCATION AND HEIGHTS OF ALL OBSTRUCTIONS. USE FAA HANDBOOK 6850.2 AS A GUIDE FOR DETERMINING OBSTRUCTIONS.
   B. DRAW A LINE FROM THE DOWNWIND BAR LOCATION TO 20' ABOVE THE MOST CRITICAL OBSTRUCTION IN THE AREA. SEE LINE $V_2 - V_3$ OF DETAIL "B".
   C. AIM THE DOWNWIND BAR AT AN ANGLE EQUAL TO THAT OBTAINED IN NOTE "B", ABOVE PLUS 0.75°, SEE LINE $V_2 - V_2'$ OF DETAIL "B".
   D. AIM THE UPWIND BAR IN ACCORDANCE WITH THE EQUIPMENT MANUFACTURE'S INSTRUCTIONS 0.6° ABOVE THE DOWNWIND BAR.
   E. THE EFFECTIVE APPROACH SLOPE OF THE SYSTEM (ANGLE B SHOWN IN DETAIL B) IS EQUAL TO THE AIMING OF UPWIND BAR. THIS ANGLE IS NORMAL 4.5° $\pm$0.5° FOR UTILITY AIRPORTS.
6. THE OPTIMUM LOCATION FOR THE DOWNWIND BAR IS 100' PLUS 200' MINUS 0' FROM THE RUNWAY APPROACH THRESHOLD. THE WHEELS OF THE MOST CRITICAL AIRPLANE SHOULD CLEAR THE RUNWAY THRESHOLD A MINIMUM HEIGHT OF 6'. WHERE THE DISTANCE BETWEEN PILOT'S EYE AND AND THE LOWEST PORTION OF THE AIRCRAFT IN LANDING ALTITUDE EXCEEDS 10 FEET, THE MINIMUM THRESHOLD CROSSING HEIGHT OF 25 FEET SHOULD BE INCREASED BY AN AMOUNT EQUAL TO THAT IN EXCESS OF THE 10 FEET.
7. WHERE TERRAIN DROPS OFF RAPIDLY NEAR THE APPROACH THRESHOLD AND SEVERE TURBULENCE MAY BE EXPERIENCED, THE EFFECTIVE APPROACH SLOPE SHOULD BE ESTABLISHED AT ITS MAXIMUM ELEVATION AND THE DOWNWIND BAR LOCATED AT ITS MAXIMUM DISTANCE FROM THE LANDING THRESHOLD IN ORDER TO KEEP AIRCRAFT AS HIGH AS FEASIBLE OVER THE LANDING THRESHOLD.
8. LOCATE THE SIMPLE AVASI AT EACH END OF THE RUNWAY.
9. SEE AC 150/5390-14B FOR CONFIGURATION AND AIMING CRITERIA FOR VASI-2.

FIGURE 4. RUNWAY LIGHTING CONFIGURATION FOR UTILITY AIRPORTS



STAKE MOUNTED FIXTURE



BASE MOUNTED FIXTURE

NOTES:

1. SEE EQUIPMENT MANUFACTURERS FOR LIGHT FIXTURE ASSEMBLY DETAILS.
2. ORIENT THE LENS OF THE L-802 LIGHT FIXTURE PROPERLY WITH RESPECT TO THE RUNWAY.

FIGURE 5. TYPICAL LIGHT FIXTURE DETAILS

4. DESIGN.

a. MIRL.

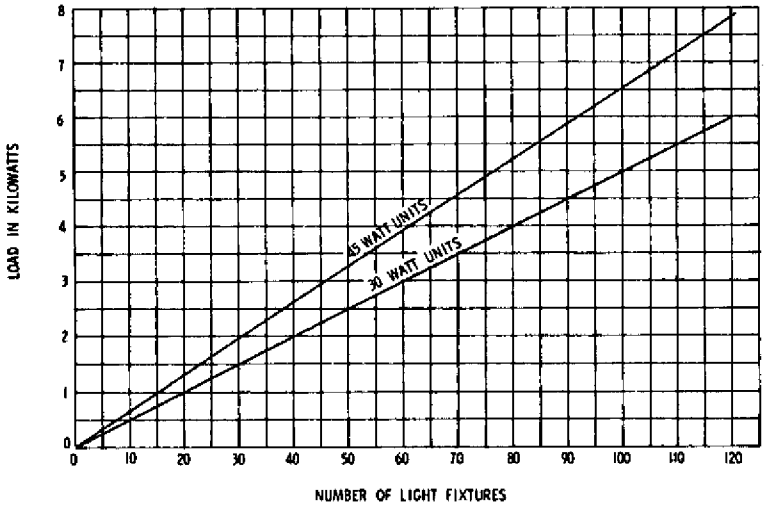
(1) Runway and Threshold Fixtures. Use either base mounted or stake (angle iron) mounted light fixtures. An identical optical system design is used for either Specification L-802 fixtures, however, the runway light utilizes a clear lens and the threshold lights utilize a green lens. See Figure 5 for typical light fixture details.

(a) Base Mounted. Mount the fixture on an approved light base and transformer housing design for off traffic use. This method provides access to transformer connectors and primary cable connectors located in the base. Provide a concrete backfill for the base. The base mounted installation is advantageous from a maintenance standpoint and provides added protection for the equipment, however, the initial installation cost is higher than that for a stake mounted fixture described in paragraph (b) below.

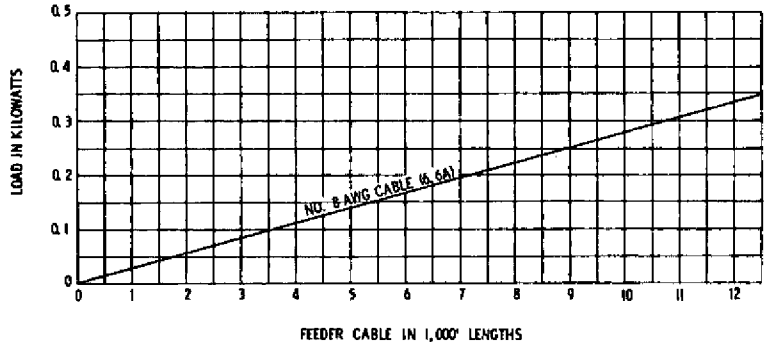
(b) Stake Mounted. Mount the light fixtures in accordance with the equipment manufacturer's instructions. Bury the associated transformers, primary cables, and cable connectors adjacent to the stake. Select a similar location for buried components at each light to facilitate the location and maintenance of the underground system. Stakes may require concrete anchors where soil is unstable. This method of design, in comparison with base mounted fixtures, costs less to install. Since the transformers, cables, and connectors are designed for direct earth burial, the underground system should provide years of fault-free service if specific instructions are followed during the initial installation. Bases may be used at selected stations in lieu of stakes to simplify maintenance; however, the initial cost of the system will increase by the amount of the base installation.

(2) Power Supply Equipment. Provide a 4KW (Specification L-811 or L-812) or 7½KW (Specification L-812) constant current regulator with taps for nominal input voltages of 208, 220, 230, 240, and 250. The Specification L-811 and L-812 regulators have three brightness settings that represent 100 percent, 30 percent, and 10 percent of runway light intensity for the respective current settings of 6.6 amperes, 5.5 amperes, and 4.8 amperes. The Specification L-811 regulators are direct controlled; whereas, the Specification L-812 regulators are remotely controlled. Use Figure 6 to estimate the KW size of the regulator.

CURVE (a)



CURVE (b)



NOTES:

1. Computations based on actual circuit load tests.
2. In Curve (a) figure K. W. load using total number of 45 watt or 30 watt fixtures connected in circuit.
3. Basis for computing unit loads in Curve (a):

30/45 watt transformer with 45 watt lamp	54.7 watts
Cable loss, lamp tolerance, etc.	10.3 watts
Total estimated load per 45 watt unit	65.0 watts
30/45 watt transformer with 30 watt lamp	40.4 watts
Cable loss, lamp tolerance, etc.	9.6 watts
Total estimated load per 30 watt unit	50.0 watts

4. Basis for computing load per 1,000' of No. 8 AWG cable in Curve (b): $I^2R = (6.6A)^2 \times 0.6405$ ohms/1,000' = 27.9 watts/1,000'
5. Obtain total K. W. load per runway circuit by adding K. W. loads obtained from Curves (a) and (b).
6. Add 225 watts for each Simple AVASI light unit

FIGURE 6. CURVES FOR ESTIMATING KILOWATT LOADS FOR MEDIUM INTENSITY RUNWAY LIGHTING CIRCUITS

(a) Direct Control. This type control is designed and furnished as an integral part of the Specification L-811 regulator. The panel has an on-off control, a brightness selection, and auxiliary circuit breaker switches. The regulator with controls is designed for indoor use. See Figure 7 for a typical wiring diagram of a direct controlled system.

(b) Remote Control. This type control is furnished as a complete unit designed and manufactured in accordance with Specification L-821. Normally, the L-821 panel is installed at a location remote with respect to the Specification L-812 regulator. See Figure 8 for typical wiring diagrams of remote controlled systems.

1 Control-120 Volts, 60 Hz. Use the Specification L-821 main contactor and brightness control relays. Connect the L-821 panel and L-812 regulator with number 12 AWG control cable in accordance with Specification L-824. Calculate the maximum permissible separation between the control panel and the regulator. Sample calculations and estimating curves are shown in Figure 9. If the distances exceed those determined by Figure 9, use low-burden, pilot auxiliary relay having a resistance and pull-in voltage adequate for the desired separation. A typical low-burden relay is shown in Figure 8b.

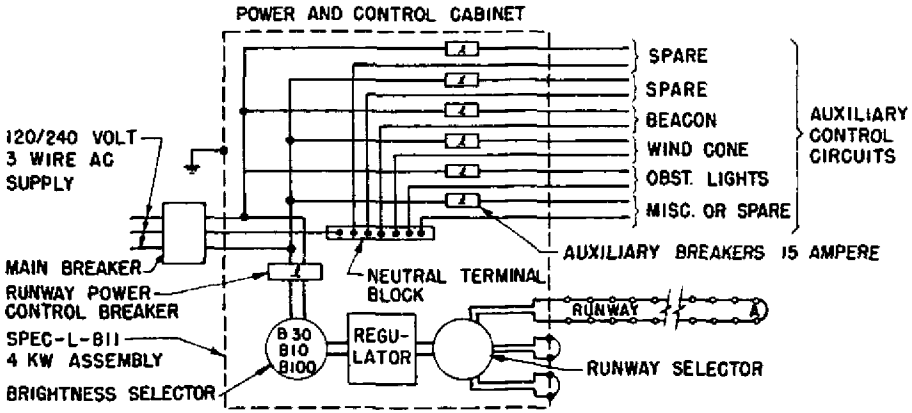
2 Control-48 Volts DC. Use a low voltage direct current auxiliary relay cabinet in conjunction with the Specification L-821 panel at locations where the separation between the control panel and regulator would cause an excessive voltage drop with the 120 volt, 60 Hz control system. Use Number 19 AWG telephone cable for connections between the control panel and the regulator. The direct current (DC) controlled system is adequate for separations of 1.5 miles.

b. VISUAL APPROACH SLOPE INDICATORS.

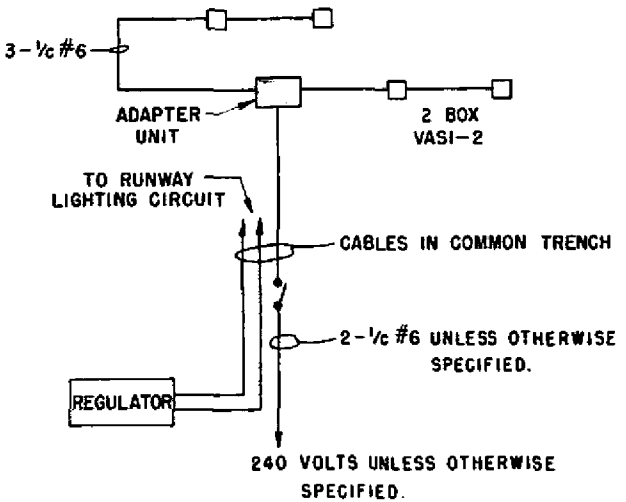
(1) VASI-2. See AC 150/5340-14B for design requirements for the standard two-box visual approach slope indicator.

(2) SAVASI.

(a) Electrical Systems. Select an adapter unit in accordance with Specification L-851 for use in conjunction with 4 SAVASI light units (two light units near each end of the



120 VOLT AC DIRECT CONTROL FOR L-811 REGULATOR



MULTIPLE CONNECTION OF VASI-2

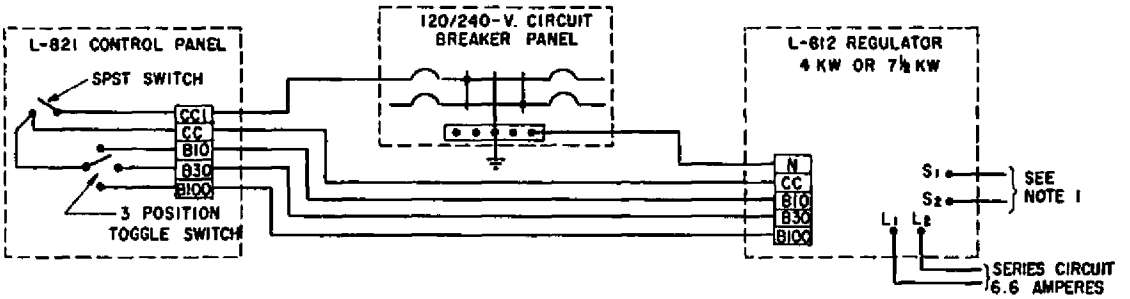
NOTES:

1. *IF THE SAVASI IS INSTALLED IN CONJUNCTION WITH THE SPECIFICATION L-811 ASSEMBLY,* USE A SPARE CIRCUIT BREAKER SWITCH ON THE ASSEMBLY TO CONTROL ON-OFF OPERATION OF THE SAVASI LIGHT UNITS.

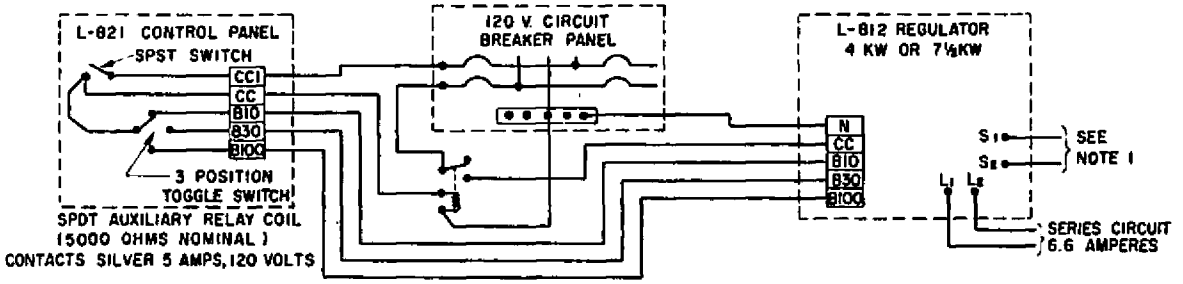
2. IF THE VASI-2 IS INSTALLED IN CONJUNCTION WITH THE SPECIFICATION L-811 ASSEMBLY THE SPARE CIRCUIT BREAKERS HAVE INADEQUATE CAPACITY, THEREFORE, THE MULTIPLE CONNECTION WITH A REMOTE SWITCH SHOULD BE SELECTED.

3. SELECT A VASI-2 REMOTE SWITCH THAT HAS ADEQUATE CAPACITY FOR CONTINUOUS OPERATION OF A 2 KW INDUCTIVE LOAD.

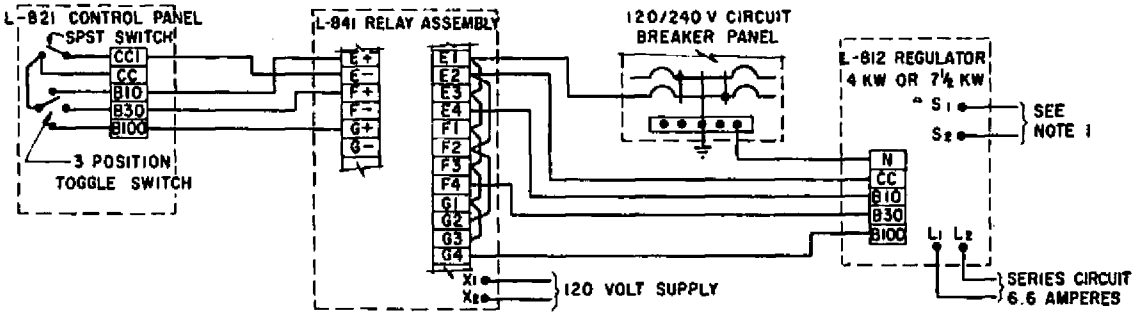
FIGURE 7. TYPICAL DIRECT CONTROLLED REGULATOR



(a) CONTROL 120 VOLTS, 60 Hz



(b) CONTROL 120 VOLTS, 60 Hz UTILIZING AN AUXILIARY RELAY FOR L-812 REGULATOR



(c) CONTROL 48 VOLTS, DC

NOTES:

1. THE L-812 REGULATOR IS SHIPPED WITH ITS INPUT CONNECTED FOR 240 VOLTS OPERATION. RECORD THE INPUT VOLTAGE AT THE LOCATION THE REGULATOR IS TO BE INSTALLED AND CONNECT THE INPUT TAP SO THAT THE MAXIMUM MEASURED VOLTAGE WILL NOT EXCEED THE REGULATORS TAP RATING.

2. INSTALL THE L-821 PANEL, L-841 PANEL, AND L-812 REGULATOR IN ACCORDANCE WITH THE MANUFACTURER'S INSTRUCTIONS.

3. MAKE THE INSTALLATION IN ACCORDANCE WITH THE NATIONAL AND LOCAL CODE REQUIREMENTS.

FIGURE 8. TYPICAL REMOTE CONTROLLED REGULATORS

ELECTRICAL COMPONENT OPERATING CHARACTERISTICS

COIL	REGULATOR SIZE	COIL RESISTANCE	OPERATING VOLTS	IN RUSH CURRENT	PULL IN VOLTS	HOLDING CURRENT	DROP OUT VOLTS
PRIMARY CONTACTOR	4 KW		120	1.4	99	0.22	77
BRIGHTNESS RELAY	4 KW		120	0.92	99	0.20	77
PRIMARY CONTACTOR	7½KW		120	5.0	99	0.78	77
BRIGHTNESS RELAY	7½ KW		120	0.93	99	0.38	77
AUXILIARY RELAY	SPDT	5000 OHMS	120	----	100	0.024	70

NOTES:

1. IT IS NOT NECESSARY TO CONSIDER LOSS IN LINE CONNECTED TO B - SINCE THE LINE LOSS IN THIS CIRCUIT IS LESS THAN THAT IN CIRCUIT CC.
2. SEE FIGURE 9 FOR WIRING DIAGRAM.

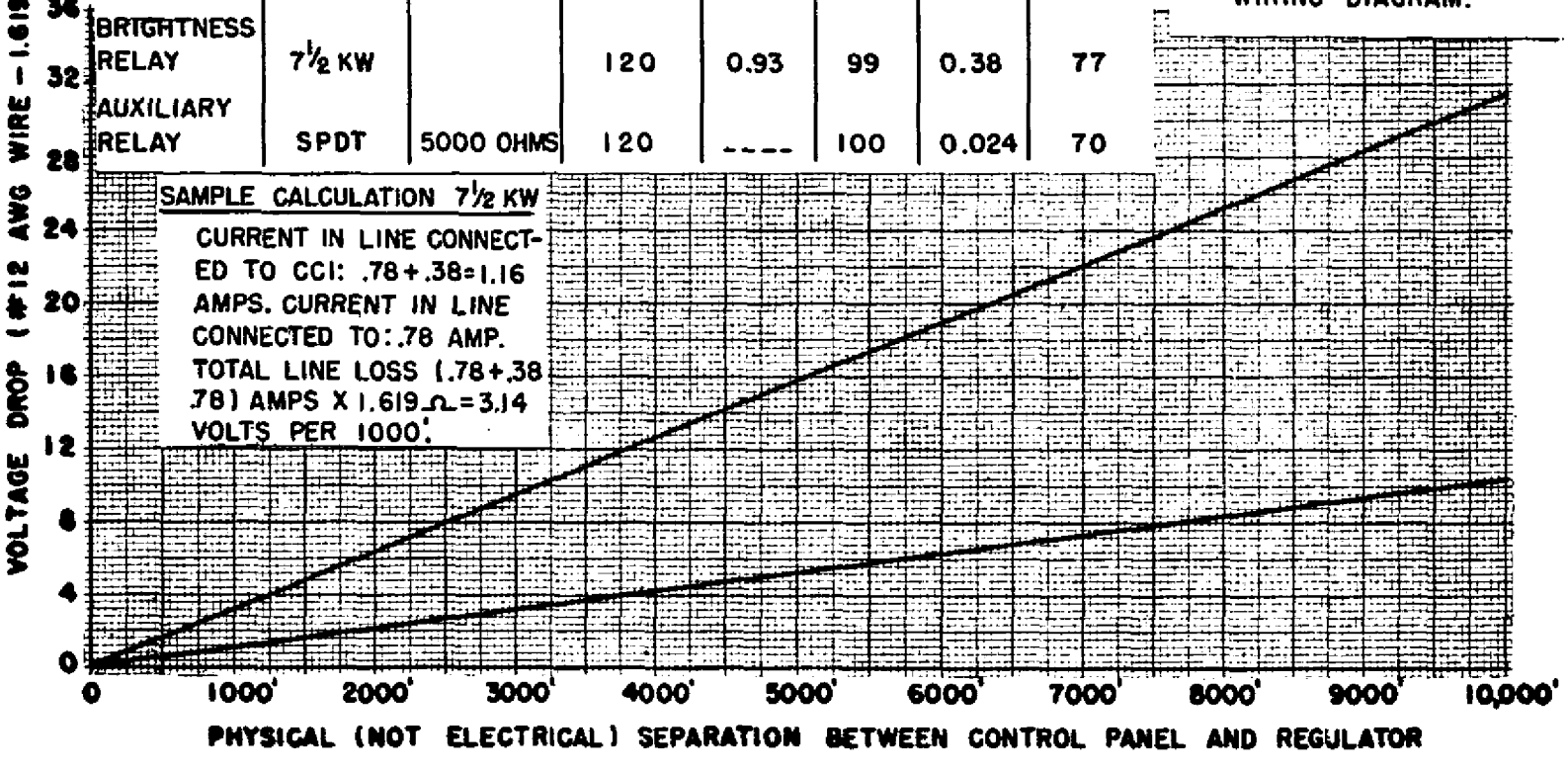


FIGURE 9. CURVES FOR ESTIMATING LOSS IN CONTROL CABLES

runway). The adapter unit has provisions to shut the system down if an open filament occurs in the SAVASI light unit or if there is a gross change in the original aiming of the light units. The 4 SAVASI light units and the adapter unit are a minimum 1.5 kilowatt load. A photoelectric switching device is provided with the adapter to change the light intensity from a high to a low setting for daytime and nighttime, respectively.

1 Continuous Operation. Provide a continuous source of 120 volts, 60 Hz to the adapter unit to permit the operation of four SAVASI light units (one system on each end of the runway).

2 Multiple Operation. Provide a switch to control the input voltage into the SAVASI adapter unit. See Figure 10 for a typical wiring diagram and Figure 11 for typical connection details.

3 Wire and Cables. Use wires and cables in accordance with Specification L-824. See applicable wiring diagrams for wire and cable layouts.

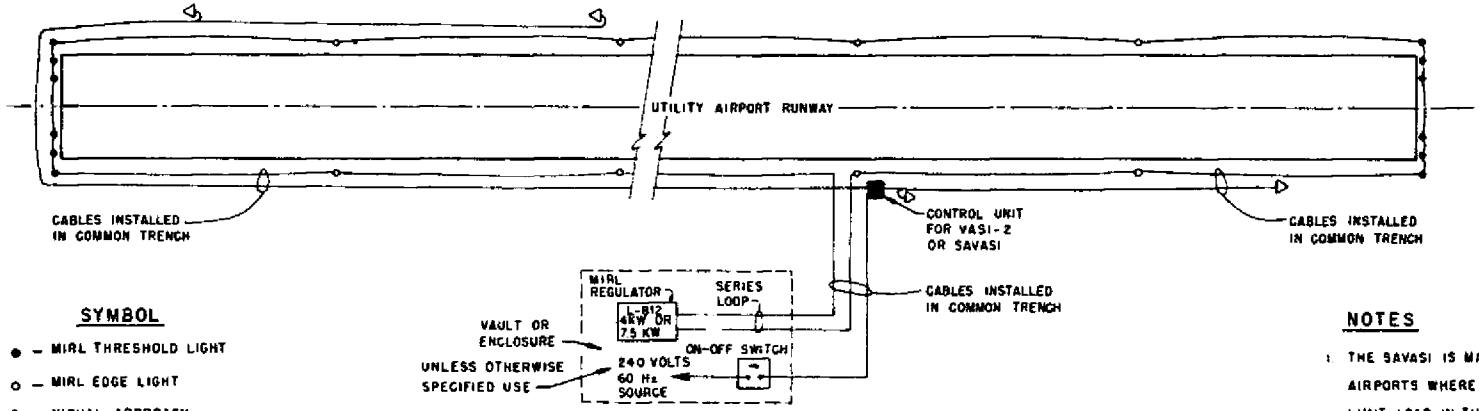
(b) Mounting Details. Provide a stable foundation for the SAVASI to permit the system to display reliable signals. Provide frangible supporting legs for the SAVASI lamp housing and adapter units installed above ground elevation. Use disconnect plugs and receptacles in conjunction with the supporting legs.

c. Duct and Conduit System

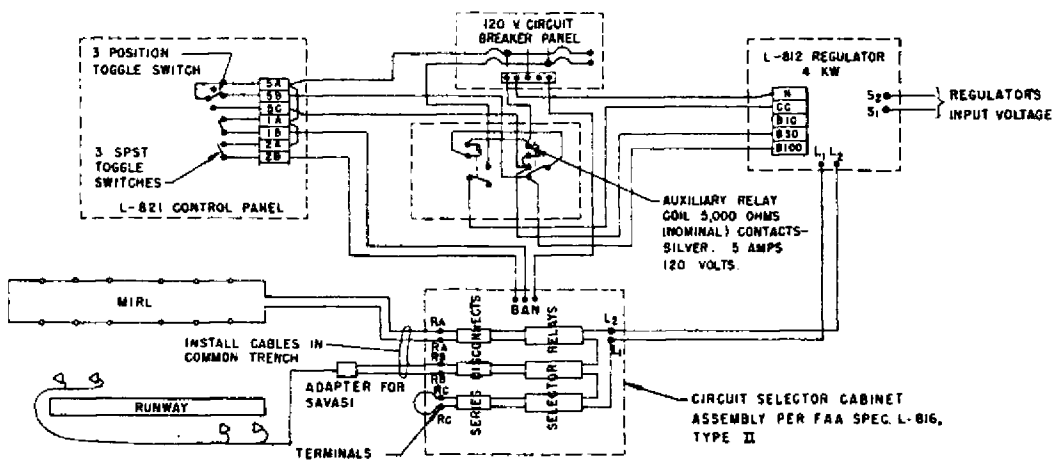
(1) Layout. Make a thorough study of the lighting layout prior to designing a duct or conduit system to determine the following:

(a) Exact location of the duct or conduit crossings under pavements so that connection for cable runs through other transverse duct or conduit can be made.

(b) Where to provide a reasonable number of spare ducts and conduits in each bank for maintenance and future expansion of facilities.



a. SERIES CONNECTION OF MIRL - MULTIPLE CONNECTION OF VASI-2 OR SAVASI

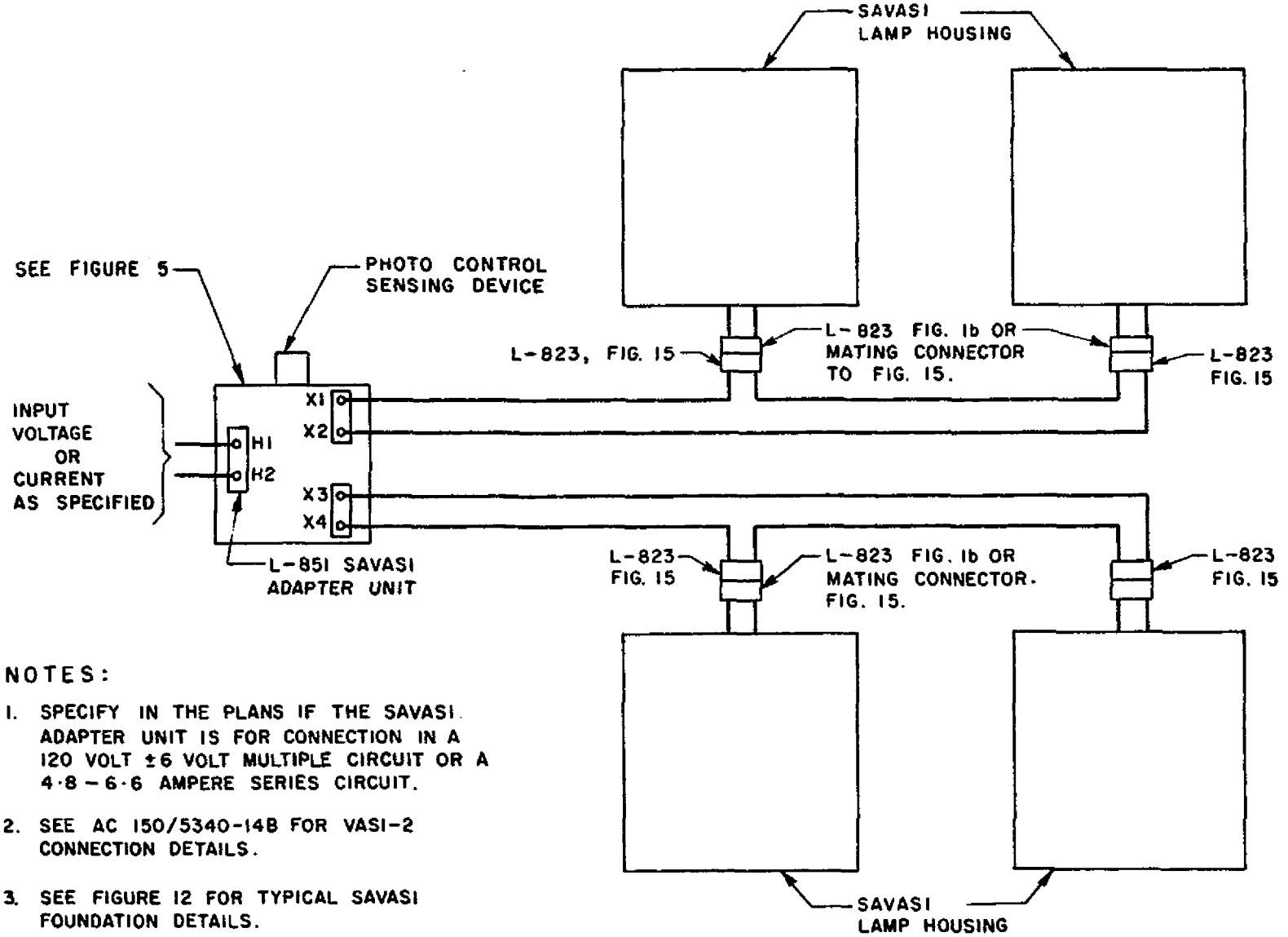


b. SERIES CONNECTION OF MIRL AND SIMPLE AVASI WITH SEPARATE CONTROLS

NOTES

1. THE SAVASI IS MANDATORY AT UTILITY AIRPORTS WHERE THERE IS A NEED TO LIMIT LOAD IN THE LIGHTING CIRCUIT. USE VASI-2 IN LIEU OF SAVASI IF ELECTRICAL LOAD IS NOT A PROBLEM.
2. THE VASI-2 ADDS AN EXCESSIVE LOAD TO A 4 KW REGULATOR WITH MIRLS CONNECTED, THEREFORE FIGURE b CANNOT BE USED WITH VASI-2. HOWEVER FIGURE b CAN BE USED FOR SAVASI.
3. USE FIGURE A FOR VASI-2 INSTALLATION.

FIGURE 10. TYPICAL WIRING DIAGRAMS FOR SAVASI ON UTILITY AIRPORTS



NOTES:

1. SPECIFY IN THE PLANS IF THE SAVASI ADAPTER UNIT IS FOR CONNECTION IN A 120 VOLT ±6 VOLT MULTIPLE CIRCUIT OR A 4·8 – 6·6 AMPERE SERIES CIRCUIT.
2. SEE AC 150/5340-14B FOR VASI-2 CONNECTION DETAILS.
3. SEE FIGURE 12 FOR TYPICAL SAVASI FOUNDATION DETAILS.

FIGURE 11. TYPICAL SAVASI CONNECTION DETAILS

(2) Requirements. Select duct and conduit that meet the dimensions and design requirements of local and national electrical codes. Where ducts are in tiers, use the lowest ducts to receive cables first, with spare ducts left in the upper levels.

5. EQUIPMENT AND MATERIAL

a. Specifications. Equipment and material are covered by FAA specifications in "Bibliography" in Appendix 2. Where L-108, L-109, L-110, and L-125 are mentioned in succeeding paragraphs, they refer to installation specifications in AC 150/5370-1A, Standard Specifications for Construction of Airports.

b. Commercial Equipment. Use distribution transformers, oil switches, cutouts, relays, terminal blocks, transfer relays, circuit breakers, and other regularly used commercial items of equipment not covered by FAA specifications which conform to the rulings and standards of the electrical industry.

c. Electrical Vault. Provide the type vault shown in the construction plans. Construct the vault of reinforced concrete, concrete masonry, or brick as specified in Item L-109. If specified, provide a prefabricated metal housing in accordance with AC 150/5340-9.

d. MIRL Light Fixtures. Use Specification L-802 runway lights in accordance with the requirements of AC 150/5345-20. Each light fixture is furnished with an optical system, lamp, connecting leads, and a mounting assembly. Use a 30 watt, 6.6 ampere lamp in runway edge fixtures and a 45 watt, 6.6 ampere lamp in threshold fixtures.

e. MIRL Insulating Transformers. Use Specification L-833 insulating transformers in accordance with AC 150/5345-31A in conjunction with the Specification L-802 light fixtures.

f. MIRL Stakes (angle iron) and Bases. Select Specification L-802 stakes in accordance with AC 150/5345-20 and Specification L-809 bases in accordance with AC 150/5345-6. If specified, select squeeze connectors in accordance with Item L-125 for installation in the L-809 base hubs. If specified, use hot dipped galvanized pipe reducing bushings in the 2-inch hub of the L-809 bases in conjunction with the squeeze connectors.

g. VASI Equipment. Select Specification L-851 SAVASI and VASI-2 equipment in accordance with AC 150/5345-28A. The lamp housings are furnished with lamps and other accessories specified in AC 150/5345-28A.

h. SAVASI Selector Switch. If specified, use a Specification L-816 selector switch in conjunction with the Specification L-812, 4KW regulator (paragraph i below).

i. Regulators. Select Specification L-811 or L-812 constant current regulators in accordance with AC 150/5345-18, or AC 150/5345-11, respectively. The Specification L-811 regulator is directly controlled, whereas, the L-812 regulator is remotely controlled.

j. Primary Cables. Select Specification L-824 cables in accordance with AC 150/5345-7. Use the type, AWG wire size, and voltage rating specified in the plans.

k. Control Cables.

(1) When AC control circuits are specified, use Specification L-824 control cable containing Number 12 AWG wires. See AC 150/5345-7 for details concerning this wire.

(2) When DC control circuits are specified, use control cable containing Number 19 AWG wires. See Rural Electrification Administration (RAE) Bulletin 345-14 for details concerning this cable.

l. Counterpoise Wire. If specified, select bare counterpoise wire conforming to the requirements in Item L-108.

6. INSTALLATION. Install the lighting systems in accordance with Item L-125. Additional installation details are contained in the following paragraphs. Check equipment covered by FAA specifications to assure that the manufacturers are approved suppliers before ordering or installing equipment.

a. Vault. Provide the airport transformer vault and vault equipment in accordance with the requirements in AC 150/5370-1A, Item L-109. Install the vault equipment, conduit, wires and cables, bus bars, and accessories necessary to insure a complete and electrical distribution center for the lighting systems in the plans. When specified, install standby power equipment in accordance with AC 150/5340-17.

b. MIRL Light Fixtures. Use the manufacturer's instructions to assemble the light unit. Install a 30 watt lamp in the runway edge fixture and a 45 watt lamp in the runway threshold fixture. The fixture's lead has a Specification L-823 plug that mates with the Specification L-823 receptacle of the Specification L-833 insulating transformer. Install light unit 14 inches maximum above the finished grade.

(1) Base Mounted. Install the L-809 light base in undisturbed soil. Use a concrete backfill, unless otherwise specified, around the base as shown in Figure 5. If required, use a jig to hold the base at the proper level and in the proper alignment. Level the base within 1 degree of the finished grade. Slope the concrete away from the flange portion of the base so that a minimum of concrete is exposed above the leveled soil around the base. Mount fixture on light base, make necessary connections, and use the fixture's adjustments to level the light within 1 degree as specified by the equipment manufacturers instructions. Use sighting device included in fixture's design to assure proper alignment. Assign each unit an identification number by one of the following methods:

(a) Using black paint, stencil numbers (with a 2-inch minimum height) on the runway side of the base plate.

(b) Install, under the head of the base plate bolt, a non-corrosive disc of a 2-inch minimum diameter with numbers permanently stamped, cutout, or engraved in the surface of the disc.

(c) Impress the number on a visible portion of the concrete backfill.

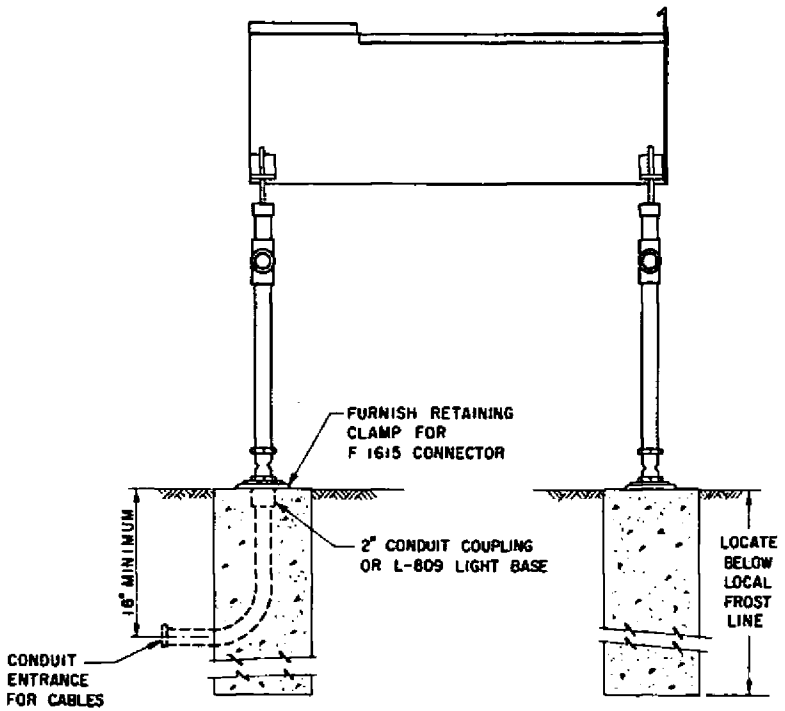
(2) Stake (angle iron) Mounted. Install the angle iron in a 6-inch hole at a depth of 30-inch as shown in Figure 5. Do not install angle iron by driving. Make the stake vertical within 1 degree. Make electrical connections and backfill around the angle iron installation with thoroughly compacted earth passing a 1-inch sieve. Level the light unit within 1 degree and properly align and orientate the optical system in accordance with manufacturers' instructions.

(3) Breakable Coupling. Install the shearing groove of the breakable couplings not more than 2-inches above the finished grade.

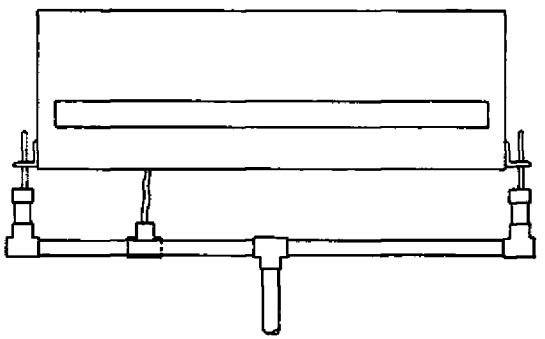
c. Visual Approach Slope Indicators.

(1) VASI-2. Install the 2-box VASI in accordance with AC 150/5340-14B.

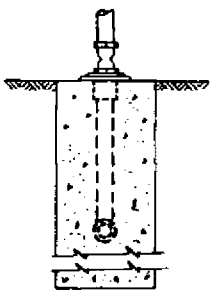
(2) SAVASI. Install the equipment for the SAVASI system in accordance with the manufacturers' instructions. See Figure 12 for typical foundation details. Provide breakable coupings on the SAVASI mounting legs. Apply the VASI-2 obstruction clearance requirements to SAVASI, unless otherwise specified.



SIDE ELEVATION



FRONT ELEVATION

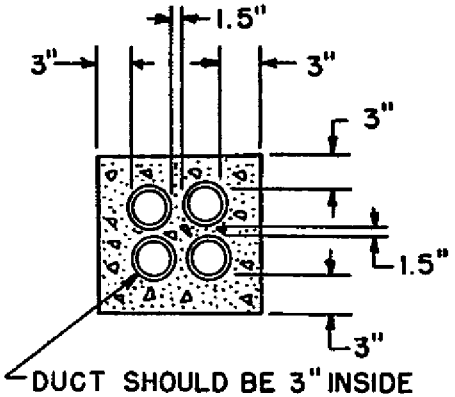


DETAIL FRONT VIEW

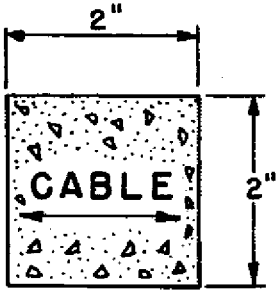
NOTES:

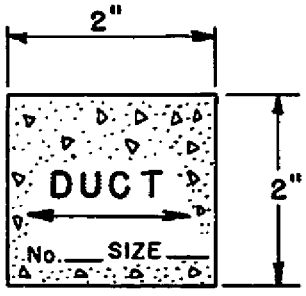
1. SEE MANUFACTURER'S INSTRUCTIONS FOR LOCATION OF CONCRETE PEDESTALS.
2. INSTALL CABLES IN ACCORDANCE WITH THE REQUIREMENTS AC 150/5370-1A, ITEM L-108.
3. INSTALL CONCRETE FOR PEDESTALS IN ACCORDANCE WITH REQUIREMENTS OF AC 150/5370-1A ITEM P-610.
4. SEE FIGURE 5 FOR WIRING DIAGRAM.

FIGURE 12. TYPICAL SAVASI FOUNDATION DETAIL



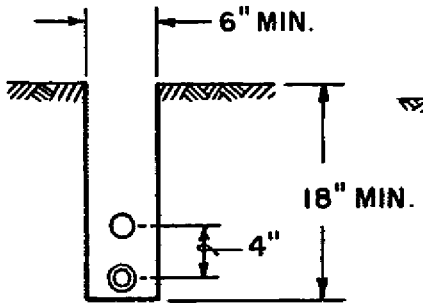
TYPICAL 4 - WAY DUCT DETAIL



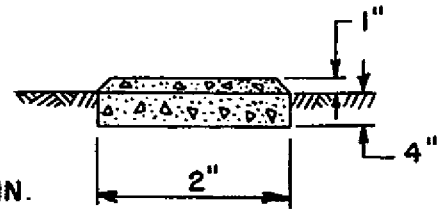


NOTES:

1. REFER TO ITEMS L-108 AND L-110 FOR ADDITIONAL INSTALLATION DETAILS FOR CABLE, DUCT, CONDUIT, MARKERS AND TRECHING.
2. LETTERS 4" HIGH, 3" WIDE WITH WIDTH OF STROKE $\frac{1}{2}$" AND $\frac{1}{4}$" DEEP.



TYPICAL TRENCH DETAIL AND WIRE PLACEMENT



TYPICAL CABLE AND DUCT MARKER DETAIL

FIGURE 13. TYPICAL DUCT MARKER AND TRENCH DETAILS

d. Frost Area Installation. In areas that have experienced problems with frost conditions, install the equipment as follows:

(1) Mount all runway lights on bases which are installed in concrete backfill with conduit hubs sealed, unless otherwise specified.

(2) Where base mounted units are not recommended, install stake mounted units in the following manner:

(a) Where the frost line depth exceeds the minimum cable installation depth as specified in AC 150/5370-1A, Item L-108, increase to a maximum of 2 feet in depth the installation of the cable, transformers, and connectors.

(b) Do not use connector clamps on the stakes.

(c) Install primary cable connectors, splices, and transformers at the same depth and in the same horizontal plane as the primary cable with adequate slack provided. The radius of cable bends should not be less than 10 inches.

(d) Place the secondary leads from the transformer to the lamp socket in a loose spiral with excess slack at the bottom.

(e) Concrete anchor, if specified, for the stake should be the size adequate for the location. Install stake at designed shoulder elevation plus 1/2 inch minus zero inch.

(f) Eliminate backfill material which will hold moisture and substitute permeable backfill material, such as sand, around the primary connectors, transformer, and secondary leads; then cover the top surface with impervious material to reduce moisture penetration.

e. Cable Installation and Connections. See AC 150/5370-1A, Item L-108 for details on cable installation and connections. Seal cable ends during construction to prevent the entrance of moisture.

f. Duct and Conduit. See AC 150/5370-1A, Item L-110 and Figure 13, Page 20, for details on duct and conduit installation.

7. INSPECTION.

a. Light Unit. Inspect each light unit to determine that the equipment has been installed at the proper location, height, and with the proper light fixture orientation and aiming of the runway edge and threshold lenses.

b. Wiring and Components. Check all wiring and electrical components (fuses, circuit breakers, transformers, switches, etc.) to determine that ratings are correct and the components are installed in accordance with local electrical code requirements.

c. Lamps. Check the voltage at the lamps to determine if the supply voltage is within specified tolerance. If a voltage in excess of rated voltage is impressed across a lamp, the life of the lamp will be reduced.

d. Securing Hardware. Check all nuts, bolts, and other hardware to determine if the components are secure.

e. Cables. Inspect cables, prior to backfilling trench, for kinks, punctures, and abrasions.

f. Installation. Check the systems' environment to determine conformance with installation requirements. Check the systems' equipment to determine that it has been assembled and placed in accordance with the equipment manufacturer's instructions.

g. Flight Check. Before commissioning, make provisions to have SAVASI flight checked to insure that the systems meet the requirements of Handbook OA P 8200.1, United States Flight Inspection Manual.

8. TESTS.

a. Operational. Operate each system not less than 1/2 hour. In addition, operate each control not less than 10 times.

b. Primary Cables. Test the circuit cables in accordance with the applicable sections of AC 150/5370-1A, Item L-108.

9. MAINTENANCE.

a. Preventive. Establish a preventive maintenance program at airports with MIRL, VASI-2, or SAVASI, to insure proper equipment operation and reliable service. The preventive maintenance program should be acceptable to the FAA. An improperly maintained system may cause equipment failure, a false signal, or rapid deterioration of the system's effectiveness.

b. Lamps. Make a daily operational check of all lighting aid fixtures to locate and replace burned-out lamps. Adequate spare lamps should be available to permit a complete replacement of all lamps in the system. The rated life of the lamp can be used to estimate interval between lamp replacements.

c. Cleaning. Clean the optical system of the lighting aids to permit light units to operate at maximum efficiency.

d. MIRL.

(1) Check all control equipment daily for proper operation.

(2) Make monthly checks of the orientation of the MIRL lens.

(3) Make semiannual voltage checks to determine if the regulators input voltage is within design limits.

(4) Check light fixture's electrical parts annually for cracking, corrosion, or shorting. Replace parts having such defects.

(5) Periodically remove growth in the vicinity of the equipment that might interfer with proper operation of the lighting system.

(6) Make additional periodic inspections and checks recommended by the equipment manufacturer.

e. Two-Box VASI and SAVASI.

(1) Daily Checks.

(a) Make daily checks of lamps and the aiming of the initial VASI installation to insure stabilization of the system. After stabilization is assured, the aiming of the light units should be checked weekly. The aiming device furnished by the equipment manufacturer or a transit can be used for these checks. Keep a record of all angular settings made to the VASI system together with dates such settings were made.

(b) Check all control equipment for proper operation.

(2) Weekly Checks. Make inspections of mechanical parts for cleanliness and structural defects such as chipping, cracking, or bending.

(3) Semiannual Checks. Make voltage checks to determine if input voltages are within design limits.

(4) Annual Checks. Check electrical parts for cracking, corrosion, or shorting. Replace parts having such defects.

(5) Unscheduled Checks.

(a) Remove growth in the vicinity of the equipment that might interfere with proper operation of the lighting system.

(b) If the light units are accidentally or purposely removed from the mounting legs, the reinstalled system should be flight checked.

(c) Make additional periodic inspections and checks recommended by the equipment manufacturer.

(6) Leveling Device Checks. The leveling device is a precison instrument, factory calibrated, with a laboratory standard and should be handled and stored with care to retain its accuracy. With careful handling, it is unlikely that the instrument will be out of adjustment; however, the device can be checked for accuracy by the following method.

(a) Select an unwarped table or bench and level it with a carpenter's level.

(b) Set the level dial to 0°.

(c) With equal size blocks inserted under the channel of the level bar near each end, the bubble should appear very near (or at) the center of the level tube.

(d) Rotate the level 180° and repeat the procedure in (c) above. The bubble should appear at the same relative position in the level tube if the bench is level.

(e) If the bubble is not centered within two divisions on the level tube (each division is as specified in manufacturer's instructions) recalibrate by adjusting the level tube until the bubble appears centered with the level dial at 0°. Repeat steps (c), (d), and (e) until the bubble remains centered in each step.

(7) Lamp Life. Tests indicate that the lamps will operate satisfactorily for the rated hours of life. On the basis of these tests, a group replacement of all lamps at the end of rated hours burning at top brightness is recommended. Good lamps removed at this time can be used for interim replacements for those that blacken or fail.

f. Vaults. Keep the vault clean and uncluttered to prevent dirt from accumulating in control compartments and to allow equipment to be accessible at all times. Provide permanent legible warning signs and mount them in conspicuous locations. Use "Danger Men Working On Line" tags or signs in field lighting vaults when circuits have been disconnected for maintenance.

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1/ N.Y. metro. area includes NYC and counties of Nassau, Suffolk, Westchester, Rockland, Orange, Putman, Dutchess, Ulster, and Sullivan.

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3/ Western Pennsylvania includes counties of Potter, Cameron, Clearfield, Blair, Bedford, Fulton, and all counties west thereof.

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APPENDIX 2. BIBLIOGRAPHY

1. Obtain copies of the following Federal Aviation Administration publications from the Department of Transportation, Distribution Unit, TAD-484.3, Washington, D.C. 20590.

   a. AC 150/5340-9, Prefabricated Metal Housing for Electrical Equipment.

   b. AC 150/5340-13A, High Intensity Runway Lighting System.

   c. AC 150/5340-14B, Economy Approach Lighting Aids.

   d. AC 150/5340-15A, Taxiway Edge Lighting System.

   e. AC 150/5340-17, Standby Power for Non-FAA Airport Lighting Systems.

   f. AC 150/5345-3A, Specification for L-821 Airport Lighting Panel for Remote Control of Airport Lighting.

   g. AC 150/5345-6, Specification for L-809 Airport Light Base and Transformer Housing.

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

   i. AC 150/5345-11, Specification for L-812 Static Indoor Type Constant Current Regulator Assembly; 4KW and 7½KW; With Brightness Control for Remote Operation.

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

   k. AC 150/5345-18, Specification for L-811 Static Indoor Type Constant Current Regulator Assembly, 4KW; With Brightness Control and Runway Selection for Direct Operation.

   l. AC 150/5345-20, Specification for L-802 Runway and Strip Light.

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

   n. AC 150/5345-28A, Specification for L-851 Visual Approach Slope Indocators.

o. AC 150/5345-31A, Specification for L-833 Individual Lamp Series-To-Series Type Insulating Transformer for 600-Volt or 3,000-Volt Series Circuits.

p. AC 150/5345-35, Specification for L-816 Circuit Selector Cabinet Assembly for 600-Volt Series Circuits.

q. OA P 8200.1, United States Standard Flight Inspection Manual.

2. Obtain copies of AC 150/5370-1A, Standard Specification for Construction of Airports, and AC 150/5300-4A, Utility Airports, from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Send check or money order with your request made payable to the Superintendent of Documents in the amount of $3.50 and $1.75, respectively, for each copy. No C.O.D. orders are accepted.

3. Obtain copies of Rural Electrification Administration (REA) Bulletin 345-14, REA Specification for Fully Color-Coded, Polyethylene Insulated, Double Polyethylene-Jacketed Telephone Cable for Direct Burial, from the U.S. Department of Agriculture, Rural Electrification Administration, Information Services Division, Washington, D.C. 20250.